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The Leavitt High Duty Sewerage Pumping Engines at Boston.

We present with this the more important details of the machinery of the pumping plant at the Boston Sewerage Works, designed by E. D. Leavitt, Jr. The description is from a paper, read by Mr. Leavitt before the Boston Society of Civil Engineers:

These engines are of a special compound beam and fly-wheel type, designed for the service, which it is hardly necessary to say, is peculiar, both in respect to quantity and quality of the material to be moved.

The leading considerations which governed the design were as follows:

1st. Such a distribution of the weight of the engines as should avoid concentrated pressure upon any point of the foundations.

2d. Placing the engines on the smallest practical area of foundations.

These considerations obtained in consequence of the character and depth of the excavation required at the site selected for the pumping station.

3d. Great strength in the details, and combination of the parts, to render liability of a breakage a minimum.

4th. Such a proportion of journals and other wearing surfaces as would allow uninterrupted operation for extended periods, with the least possible wear.

5th. Easy accessibility of all the parts for examination, repairs, and renewals.

6th. Adaptation of the pumps, and their valves to the special duty required of them, *i. e.*, to allow the passage of rags, sticks, and other small bodies not detained by the filth hoist, and in addition, such a construction as should admit the removal of an entire pump, or any of its parts, with ease and rapidity, and without disturbing any other prominent parts of the engine.

7th. A high degree of economy in the consumption of coal.

8th. Automatic regulation at different speeds.

The general construction of the engine consists in placing the cylinders, which are vertical and inverted, directly over the pumps, with the beam midway, or nearly so, between them, its journals being carried in the bed-plate.

The steam cylinders are supported by an entablature which is carried on eight strong columns, that are keyed and bolted to the bed-plate, while the pumps are hung underneath the same by strong brackets. They also obtain additional support from girders built into the masonry at the base of the delivery chambers, and their connection to the girders is such that as much, or as little, weight as desired can be placed upon them by means of jack-screws. These girders serve a further useful purpose in forming a track upon which the pumps can be run back from their normal position and removed if required.

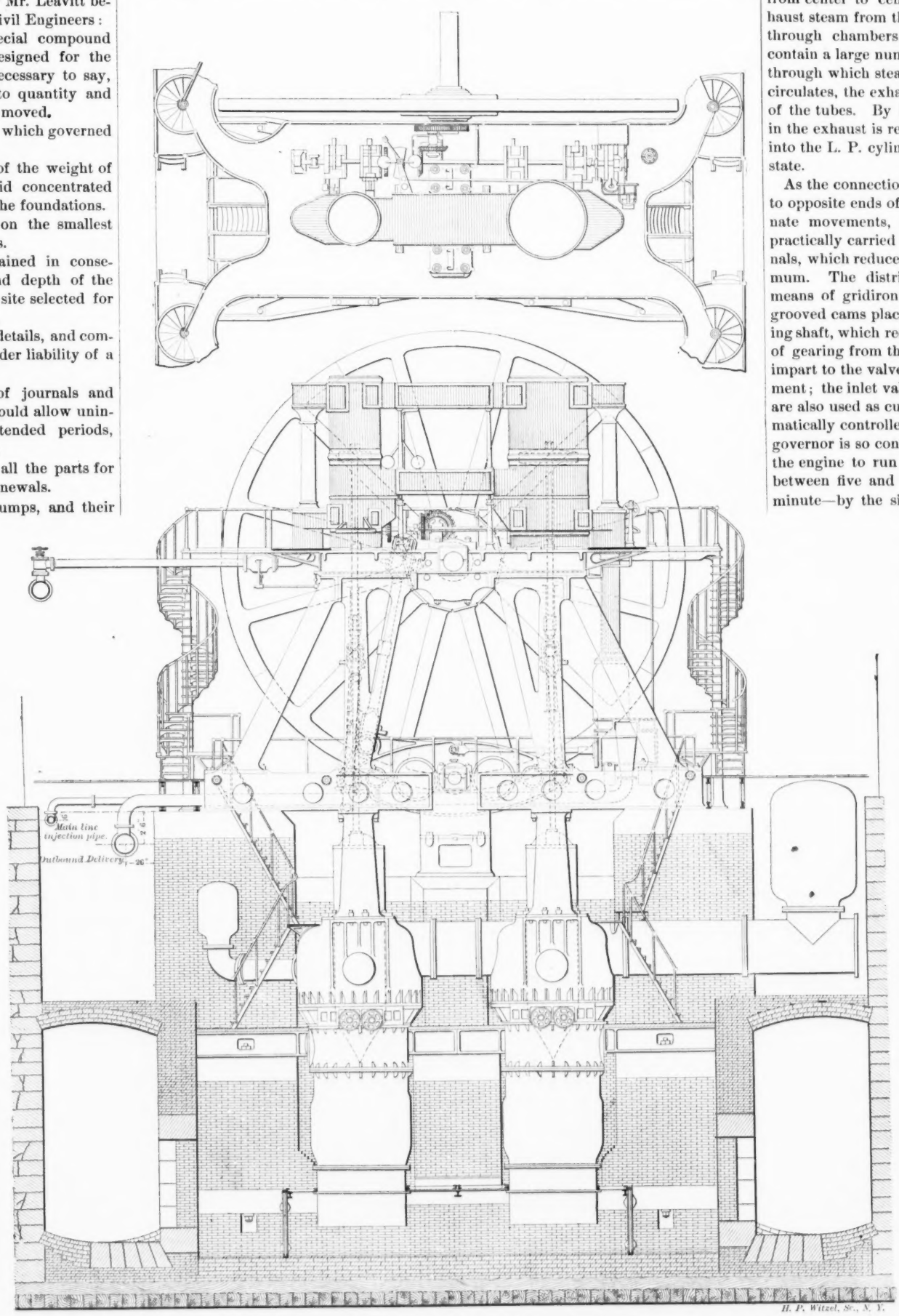
The beam is made very short, being 16 ft. 6 in. between end centers. It is connected to the main piston and plunger rods by cross-heads and links. The crank shaft is directly over the main beam center and a little below the base level of the cylinder, its journal being in the entablature. Connection from the beam to the crank is from a projecting horn, cast on the upper side of the beam, and a such an angle as to secure proper vibration.

The diameter of the steam cylinder is 25½ inches for the H. P. and 52 inches for the L. P., with a stroke of pistons of 9 feet. The horizontal distance from center to center of cylinders is 15 ft. 2 in., which is the same as from center to center of pumps. The exhaust steam from the H. P. cylinder is passed through chambers termed reheaters, which contain a large number of small brass tubes, through which steam of the boiler pressure circulates, the exhaust steam being outside of the tubes. By this means any moisture in the exhaust is re-evaporated, and it goes into the L. P. cylinder in a practically dry state.

As the connection of the steam pistons is to opposite ends of the beam they have alternate movements, and the weights are all practically carried on the main beam journals, which reduces the friction to a minimum. The distribution of steam is by means of gridiron slide valves, operated by grooved cams placed on a horizontal revolving shaft, which receives its motion by means of gearing from the crank shaft. The cams impart to the valves a short and rapid movement; the inlet valves of the H. P. cylinders are also used as cut-off valves, and are automatically controlled by the governor. The governor is so constructed that it will enable the engine to run at any required speed—between five and eighteen revolutions per minute—by the simple addition of weights to a scale beam.

In order to distribute the weight properly on the foundations the bed-plate is made very strong and massive. It consists of four cast-iron tubular girders, with their inner ends bolted to the beam pedestal, and supported on a heavy transverse girder, or bed-plate, resting on the central foundation piers. The outer ends rest on heavy masonry piers. The extreme length of the bed-plate is 39 feet 9 inches. The extreme width of the center, abreast the beam pedestals, is 12 feet, and at the ends, 16 feet. The engine is thus carried with the exception of the outboard pedestal, within a parallelogram 16×40 feet. The depth of the bed-plate girders is 3 feet, and their width across the bottom flanges is 3 feet. They are secured to the foundations by twelve bolts, 3½ inches in diameter. The total weight of the bed-plate, including the beam pedestals, which form a part of the same, is 53 tons.

Perhaps the most prominent feature of the engine is the pumps, which are of the single-acting plunger construction, 48 inches in diameter and



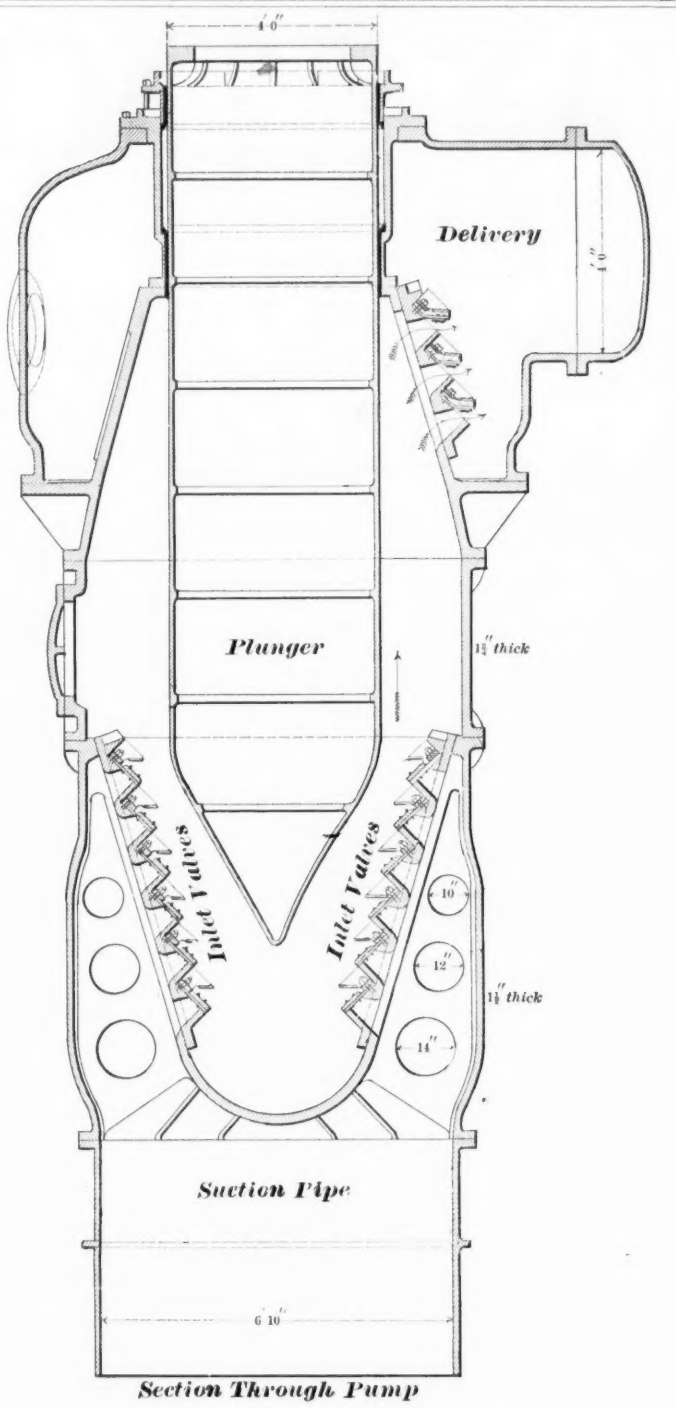
LEAVITT HIGH DUTY SEWERAGE PUMPING ENGINE.

9 feet stroke. There are seven principal parts to each pump, viz.: The upper chamber, plunger stuffing box, delivery valve seating, center-piece, lower chamber, inlet-pipe and plunger. The upper chamber, as will be seen, is cylindrical in form, and may be likened to a large inverted kettle with a hole in the bottom. It is 9 feet 6 inches internal diameter, and 6 feet 11 inches extreme height. The metal is $1\frac{1}{2}$ inches thick in the body and 2 inches thick in the flanges. The opening for the plunger stuffing box is 4 feet $9\frac{1}{4}$ inches diameter. There is a delivery nozzle 48 inches in diameter, cast on the chamber, also pads for securing the same to the bed-plates. The plunger stuffing boxes are 4 feet 3 inches inside diameter and 3 feet $5\frac{1}{2}$ inches deep, leaving a packing space of $1\frac{1}{2}$ inches. The delivery valve seatings are of the form shown in the drawing. They consist of a heavy base 18 inches high, composed of two flanges, united by the frustrum of a pyramid 7 feet 3 inches diameter at the base, and 6 feet $7\frac{1}{4}$ inches diameter at the top. Upon this base is cast the frustrum of a nine-sided pyramid 3 feet 10 inches high, having a diameter at base of 6 feet $11\frac{1}{2}$ inches, and at the top of 4 feet 9 inches. To this pyramid are bolted nine rectangular valve seats, each 3 feet 6 inches long by 21 inches wide, and arranged for 3 valves $15\times9\frac{1}{2}$ inches, which cover clear openings in the seats $13\frac{1}{2}$ inches $\times4\frac{1}{2}$ inches. The valves are of rubber $\frac{3}{4}$ inch thick and have wrought iron back and face-plates. They form their own hinges, and their construction can be clearly seen. The lower valve chambers are of cylindrical form externally, about 7 feet 6 inches in diameter, and 7 feet 10 inches high. Within these chambers are formed the foot valve seatings, which consist of inverted frustrums of a pyramid having six sides, the inscribed diameter being 6 feet $11\frac{1}{2}$ inches at the top, and $41\frac{5}{8}$ inches ditto at the bottom. There are 6 valve seats, each 6 feet 4 inches in length by 21 inches in width, and carrying 6 valves of the same dimensions as previously described for delivery. There are thus in each pump 36 suction and 27 delivery valves. The pump under the H. P. cylinder discharges through the pump under the L. P. cylinder. There is a force main from the latter 48 inches in diameter, upon which is placed, at a distance of 28 feet from center of the engine, an air vessel 6 feet 6 inches in diameter and 10 feet 2 inches high. The grates or screens for the pumps consist of cast-iron frames, and wrought-iron bars 2 inches by $\frac{1}{2}$ inch; these bars are 2 inches apart. The angle of all the valve seats is 45 degrees, and it is expected that no silt or debris of any kind will remain on them. It will be observed from the construction of the pumps that the movement of the water is opposite to that of the plungers, and that the deflection of the current is the easiest practicable under the conditions of inclined valve seats. The engines are provided with iron galleries at the base of the cylinders, which form the working platform. Also with iron floors at the level of the bed-plates, and at the top of the pumps, there has been built a tight wooden floor to prevent the escape of odors from the well; this floor has suitable traps for access to the bottom of the pumps.

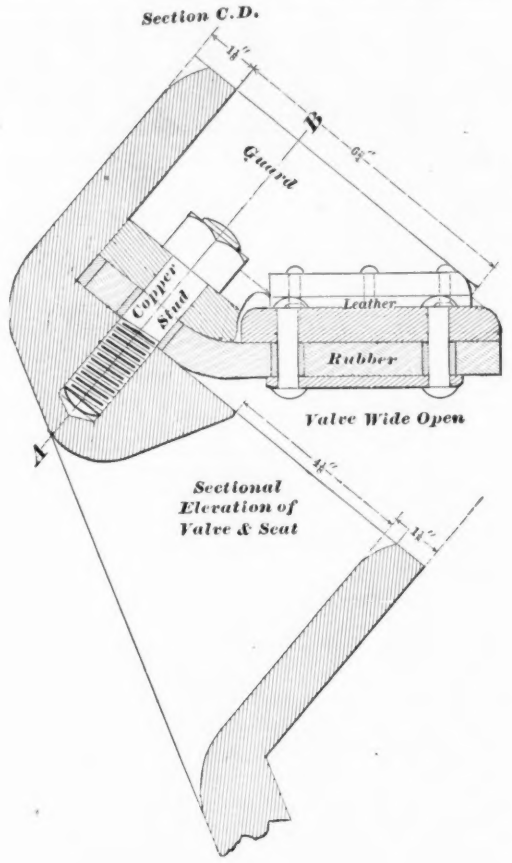
In order to facilitate the removal of the pumps, without disturbing other parts of the engine, there is attached to each delivery valve seating four trucks, which can be dropped upon the foundation girders, which are provided with grooves for the truck flanges, and the same can be run back to a convenient position for hoisting.

The fly-wheels are 36 feet in diameter and weigh 36 tons each. The shaft is of wrought iron, 17 inches in diameter at journal and 20 inches diameter in the wheel. The total weight of each engine is very nearly 900,000 pounds, of which some 227,500 pounds is in the pump and appendages. The capacity of the high duty engines is nominally 25,000,000 gallons per 24 hours, against a maximum head of 43 feet. To accomplish this a speed of about $10\frac{3}{4}$ revolutions per minute must be maintained. The engines have been run at a rate which will insure a delivery of 42,000,000 gallons per twenty-four hours, and the performance was such as to leave no doubt that such a delivery could be permanently maintained—4 per cent. slip has been allowed in these estimates of capacity. The working pressure of steam will be 100 pounds per square inch, and with this pressure the number of expansions in the steam cylinders will vary from 16 to 20, in accordance with the varying head pumped against.

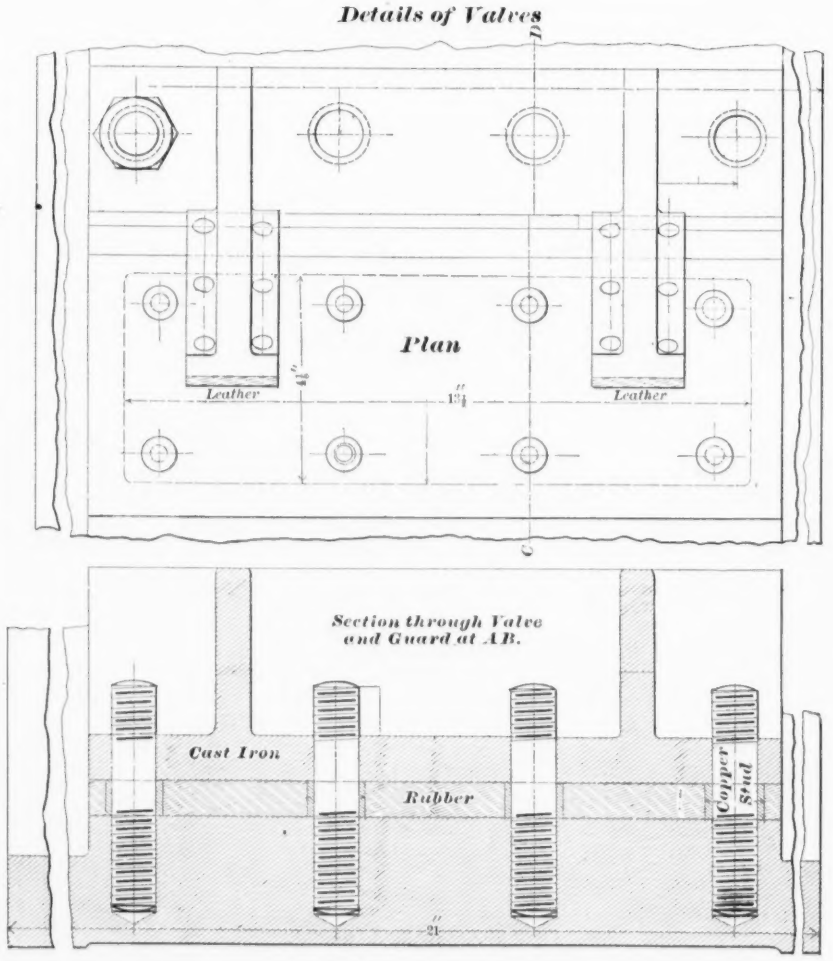
On account of the difficulty of obtaining a supply of water for the pumps no duty trial has thus far been practicable, but in the short runs that have been made a high duty has been foreshadowed.



Section Through Pump



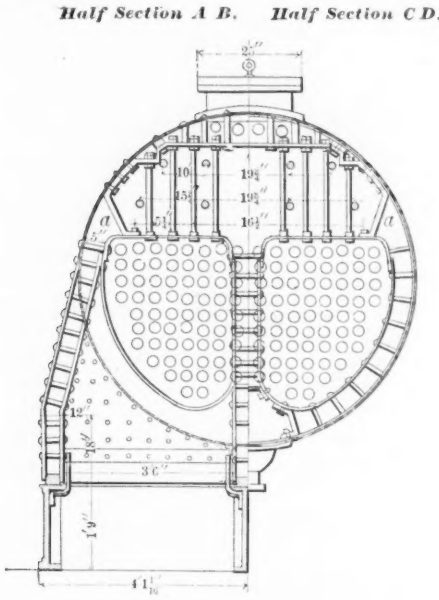
Details of Valves



THE BOILERS.

There are two boilers for each pair of engines, making four in all, and of precisely similar construction. They are of the horizontal fire-box tubular form, 31 feet $9\frac{3}{4}$ inches long over all, and 6 feet 8 inches diameter of shell; each boiler has two fire-boxes, 3 feet 6 inches wide, 5 feet 2 inches high, and 11 feet long, including the connection to the combustion chamber. The latter is 4 feet long and receives the products of combustion from both furnaces. Connected with it are one hundred and thirty-two tubes, 3 inches external diameter, and 15 feet long between the tube sheets. The grates are 3 feet 6 inches wide, by 6 feet 6 inches long. The boilers are constructed of homogeneous steel throughout, varying in thickness from $\frac{5}{16}$ inch in the furnaces to $\frac{7}{16}$ inch in the shell, and $\frac{1}{2}$ inch in the tube sheets. They are double riveted throughout. The ends of the boilers above the tubes are connected by 8 stay rods $1\frac{7}{8}$ inches diameter in the body, and $2\frac{1}{4}$ inches diameter in the thread, with nuts outside and in. The crown sheets are sustained by stay bolts running to arches, which are riveted to the shell. The sides of the furnaces are braced by screw stays $\frac{7}{8}$ inch in diameter, placed $4\frac{1}{2}$ inches from center to center. The boilers are supported at the fire-box end in cast-iron ash pits, and under the barrel by cradles and stools of cast iron, the latter resting on balls 2 inches in diameter, which allow for expansion in either direction. There are three cradles for each boiler. Each pair of boilers has a steam drum 24 inches in diameter and 19 feet 2 inches long. Steam is taken from the drums through a 10-inch pipe. The products of combustion from each pair of boilers pass around the tubes of a flue-heater, which are eighty in number—$2\frac{1}{2}$ inches inside diameter and 14 feet 10 inches long. The ends of the tubes are connected by return bends; the tubes and bends are made of brass. They are placed upon a wrought iron carriage having suitable truck wheels, and they can easily be removed from the flue for examination and cleaning. The boilers are provided with the usual valves, cocks and gauges, which it is unnecessary to describe.

The main steam pipe running from boiler-house to engine-room is 14 inches in diameter, of lap-welded wrought iron. The connection to each engine is by seamless wrought-iron pipe 7 inches in diameter. For supplying injection water there are two

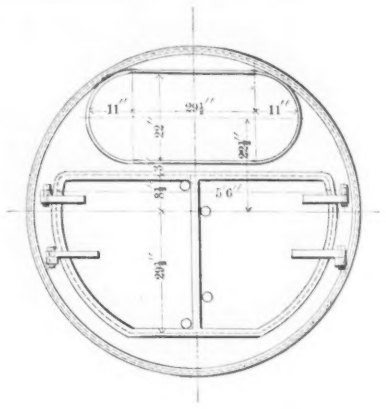


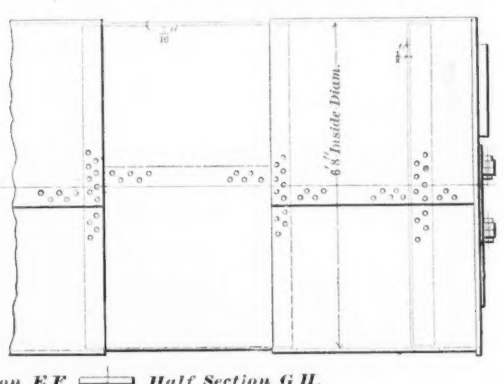
Worthington duplex pumps, having steam cylinders 7 inches in diameter, and plungers 14 inches ditto, with a stroke of 18 inches. These pumps deliver salt water into wooden cisterns from whence it is taken to the condensers of the engines.

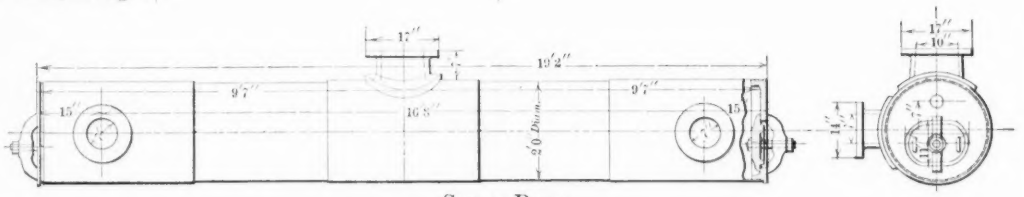
Early Use of the Extended Smoke-Box.

In a letter sent us from St. Louis, Frank C. Smith says: I met at Louisville, a few days since, Pulaska Leeds, the M. M. of the Louisville and Nashville road at that point. He gave me many interesting points relative to the extension smoke arch, etc. Some twenty years back, when he was learning his trade in the East, he was familiar with it, and Mr. E. M. Reed, now vice-president of the New York, New Haven, and Hartford Railroad, he says, used it thirty-five years ago on the Philadelphia and Wilmington Railroad. Mr. Reed informed him that originally it was of the same form as at present, saving perhaps the perforated baffle plate.

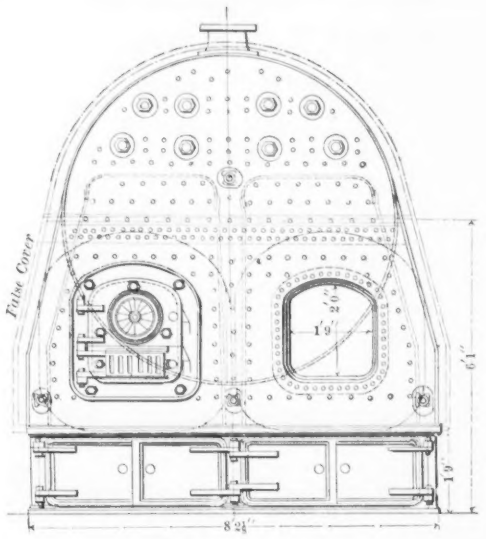
Mr. Leeds, some ten years back, brought the plan West with him, when he took charge of the Indianapolis, Decatur, and Springfield road, and from this it had a slow growth in the West, until within the past five years.







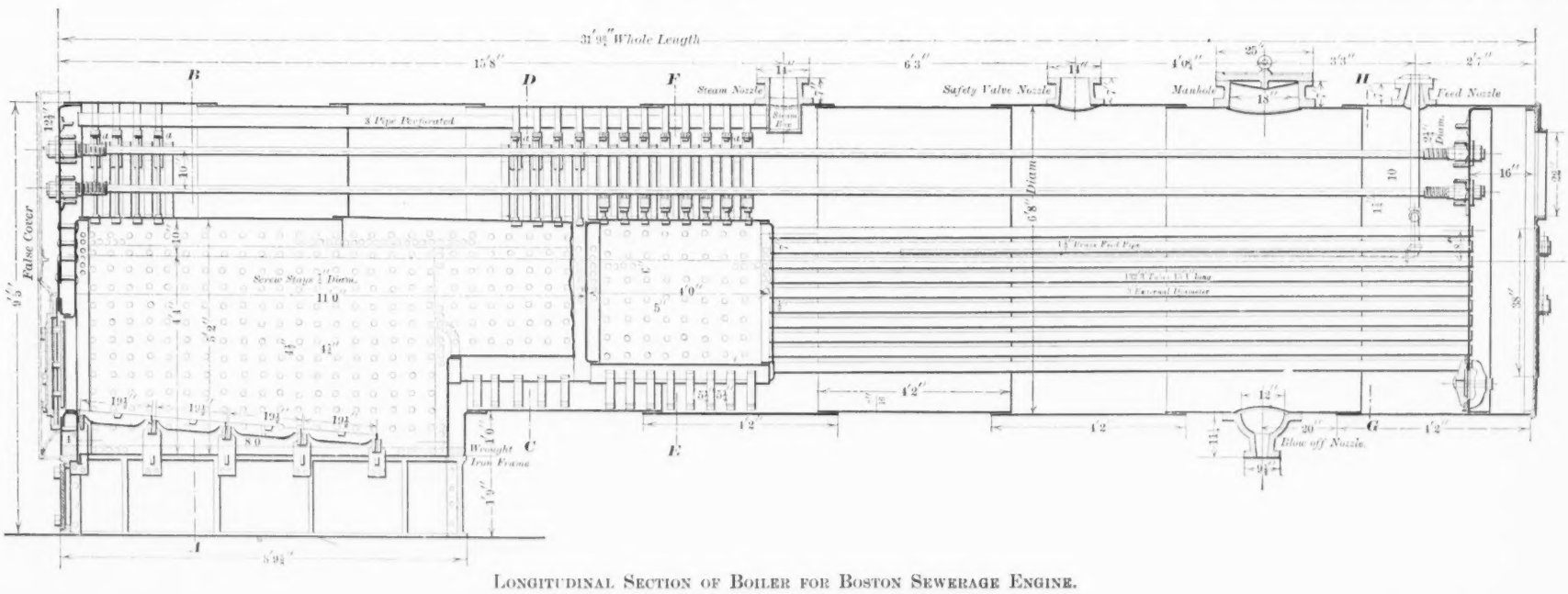
STEAM DRUM.



shops, and I doubt if any such record has yet been made. I attempted to write a biographical notice of Oliver Evans not long since, and was surprised to find how little information of any value was obtainable about a man whose mechanical fecundity was remarkable, and whose achievements revolutionized American milling."

Mexican papers, several of which are eminently enterprising and progressive beyond their surroundings, commented in a very uncomplimentary style upon the methods of that country's postal authorities because they missed sending the mail with the first through train which left the city of Mexico. Even with that slip the Mexican Government is an example of enterprise and promptitude in comparison to our own, so far as perfecting postal facilities by the new rail route is concerned. The United States Government has not yet made proper arrangements to carry mails to Mexico by the railroad, and the ridiculous spectacle is yet seen of forwarding newspapers from Denver to Mexico by the ocean route round New York.

In obedience to a command issued by the stock gamblers of Wall street, the general manager of the Union Pacific Railroad recently ordered a reduction in the wages of all employes of the company, excepting that of engineers and firemen. These two classes of railroad men are so well organized that



LONGITUDINAL SECTION OF BOILER FOR BOSTON SEWERAGE ENGINE.

Mr. Leeds believes its chief merits consist in allowing of larger nozzles and in acting as an air chamber does on a pump. He cites instances in which the most marked improvement in bad-steaming engines followed its use. The idea which has prevailed to some extent, that this device is patented, will be seen to be without foundation, as it has been in practical use for over thirty-five years.

Marine Engineer Fatally Scalded.

On the return voyage from Havana, an accident happened in the engine-room of the steamer City of Merida, which resulted in the death of the second engineer, Patrick Breslin. While Breslin was on watch, the pump, which usually draws its water from a filter, stopped working, and he proceeded to change the suction direct to the hot well. Part of the trouble was that the check valve on the boiler had stuck up, and this was not observed by Breslin. As the full pressure of the boiler struck the pump chamber, it exploded, pouring a huge volume of scalding water and steam over the second engineer. The rush of steam was so great in the engine-room that no one could get in to assist the wounded engineer until the pressure of steam was reduced on the boiler. Mr. John Walsh, the chief engineer, made every effort to rescue his assistant from the engine-room, and was severely scalded about the legs by the escaping steam. By the time Breslin was removed, he was so severely injured that he died within twenty minutes. The chief engineer saved the boiler from being burned by drawing the fires promptly.

A well-known mechanical engineer writes: "There are few men left who can give a clear account of the men and methods of early trouble was feared should an attempt be made to reduce their pay when no industrial necessity could be shown to excuse the act. The parties who managed the movement did not anticipate organized resistance from the shopmen and general workmen, but here their calculations miscarried, for the notice of reduction was followed by one of the most unanimous strikes ever known in railroad operating. Brakemen, switchmen, freight-handlers, and shopmen went out with one accord, and the movement of all trains was immediately stopped. Seeing that resistance to the pay reduction was so general, and believing the men to be firm, the general manager restored the old pay.

LETTERS FROM PRACTICAL MEN.

A Peculiar Boiler Explosion.

Editor American Machinist:

A very disastrous explosion of a stationary boiler in one of the marble quarries here occurred May 2. Six men were killed outright and another badly wounded.

I looked over the wreck carefully the day after the explosion, and found some extraordinary ruptures of the boiler shell. Both heads were torn off at the riveted joints—the first, at the front of the boiler, was split lengthways entirely around the shell (some thirteen feet); the second sheet was torn from the first at the riveted joint between the two, and also at the joint where riveted to the third sheet; the third sheet was torn from the back head, also at the riveted joint. There were, therefore, four complete transverse ruptures running entirely around the boiler. From the position of the parts after the explosion, it was apparent that the initial rupture was at the longitudinal seam of the middle sheet (there being three), to which the dome was attached. The dome, with the sheet attached, was thrown upward and laterally through the roof, and landed some ten rods north of where the boiler stood. The back head was thrown about half that distance directly east, the third or back sheet following it for perhaps thirty feet. The front head was blown directly west—say six rods—the first or front sheet following the same distance. The boiler was 54″ in diameter, and the shell $\frac{5}{16}$″ thick. Transverse seams were single riveted, and longitudinal ones double. The dome was single riveted, and had given continual trouble from leakage since starting up four or five months ago. The rivets in this dome were two or more inches from the sides, and could not be kept tight. Two caulkers or boiler makers were on top of the boiler when it exploded, having been sent out by the shop that built the boilers to repair them. There were two boilers, connected by a 4″ pipe at their domes. Feed water was introduced at the front heads, above the water line. There were no other connections between the boilers. The caulkers were testing their work by steam pressure, there being within five minutes of the explosion ninety pounds pressure in one boiler and twenty in the other. There is some evidence to show that steam was admitted from one to the other just at or before the explosion. The engine had not been running for twenty-four hours previously. The boilers were new, and had been tested by cold water pressure to 130 pounds.

What appears inexplicable to every one here is why there were four transverse ruptures. The two of the dome sheet are of course what might be looked for, but why the remaining two?

The damage from this explosion will not fall short of $25,000, a new building 80x100 feet being entirely demolished.

Gouverneur, N. Y. J. S. CORBIN.

Self-Skimming Ladle.

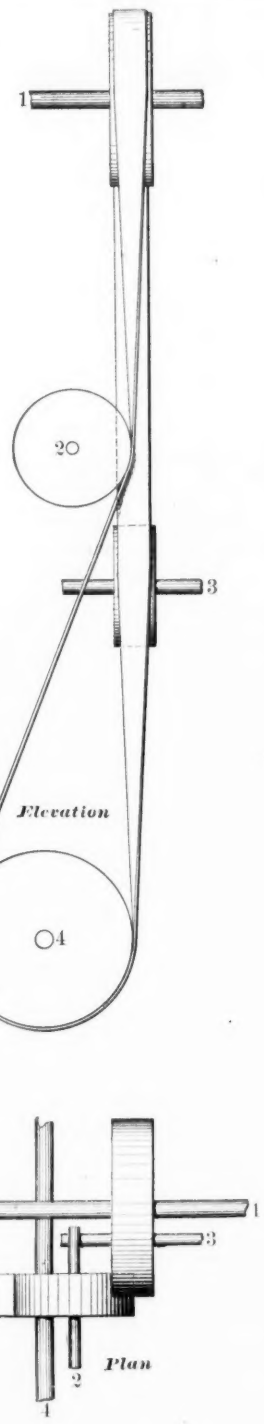
Editor American Machinist:

In your issue of May 17, M. H. P. asks me how the ladle there shown "would do to get clean iron from the bottom for fine castings? For some shops and classes of work it would be a good thing, but there are several reasons why such a ladle would not become popular. One is, in carrying the ladle long distances, and in delays, always occurring, the metal in the spout may become much less fluid than that in the ladle. This would, of course, be objectionable for light work, and for castings requiring a clean machine-shop finish.

Other objections are: It is unhandy to carry and pour in crowded places, and it is difficult to keep the spout daubed up. If the ladle were to stand long, oxide, or commonly-speaking, scum, would gather on the surface of the metal in the spout, the same as gathers on standing skimmed ladles, therefore the spout would often require skimming.

The idea is not a new one, and I believe such a ladle has been patented.

THOMAS D. WEST.



Belt Transmission.

Editor American Machinist:

In reading the communication from H. Reynolds, in a recent issue of your journal, on the subject of the quarter-twist belt as a means of transmitting power, its objections and means of doing away with it, I thought it might not be out of place to supplement his article with a little experience in another direction. In one of our large factories a quarter-twist belt, transmitting about 20-horse power, had been running for years, giving constant annoyance because of the strain on the edge, and tearing out of the lacings at that part of the belt. A plan, which I suggested, was substituted recently, and has given entire satisfaction. I offer it to your readers as a simple expedient in case of need. The accompanying diagram will I trust explain itself. The idle pulleys throw a quarter twist in the belt, but preserve the full and close contact of the belt on the driving and driven pulleys. A. C. CAMPBELL.

Foundry Economy—Melting Nine to One—Draft and Finish of Patterns.

Editor American Machinist:

I have read much, and heard more, about economy in melting iron; about melting nine to one, etc. It has been stated that the use of more fuel than one to eight was downright robbery of owners. Now, I recently visited a shop where it was claimed they were melting nearly nine pounds of iron to one pound of fuel (coke), and I am free to make—in fact, desirous of making—it known, that I do not melt iron the way I saw it done there. I have not the slightest ambition to see my ladles all bunged up in the middle of the heat, the moulders irritable and discouraged at seeing their work with rounded and coal-sheddy corners, and little dabs of iron poured out all around, at the most convenient place, to prevent freezing in the ladle. Now, the question comes up, is that economy?

At another foundry I visited, the owner was living in a state of ecstatic joy, quite intoxicated with the idea of his foundry economy. He was bound to have his iron melted eight pounds to eight and a half pounds of iron to one pound of coke or fuel. I took the pains to look over his dump and see the cupola returns, and was satisfied that considerable more castings could be made from 100 tons of iron than he was getting. That dump was a bonanza for all the gamins in the neighborhood. He was putting his foundryman on an allowance for fuel, but there was a big leak at the bunghole, while the spigot was too carefully watched. A rattling cinder mill would have saved 90 per cent. of the iron wasted, but he claimed that it would cost money to put up a mill and run it.

I think it is possible to look at cupola dump and estimate pretty nearly the amount of fuel used in proportion to iron by the quantity of shot in the dump.

It is fair to assume that different cupolas need different treatment. All work does not require equally fluid metal, but to get thoroughly mixed, homogeneous metal, it must be melted hot, yellowish white on a clear day, and as fluid as water, otherwise the castings will be liable to have hard spots and streaks.

I have met and compared views as to the necessity of melting iron hot to get a homogeneous iron in the casting, with a half dozen prominent pig iron producers, both in the anthracite and coke regions. These gentlemen have given pig or cast iron more thought individually than most experienced foundrymen, and they all, without exception, advocated melting at a high temperature, and deprecated the theory of 9 to 1, 10 to 1, $8\frac{1}{2}$ to 1, or any fixed amount, but use no more fuel than is necessary to produce good liquid iron and keep the cupola hot to prevent shot and bugs lodging and accumulating in the spent fuel—inevitable around the tuyeres. Opinions coming from professional iron makers are worth heeding, and respectful consideration.

I claim that castings are softer, cleaner, and stronger; more castings are saved and made in each heat from a given quantity of iron charged in cupola, all things else being equal, where iron is melted hot and liquid, than when it is (as I claim) but partially melted. Moulders will also work more days in the year, where they can handle lively good running iron and keep their ladles clean, light, and neat, than where they have to *throw* iron into a mould, and then dump what is left at the nearest place, to preserve the ladle.

Did it ever occur to the owner or superintendent of a pattern shop and foundry that the pattern making had a vital influence on the cost of producing castings? A pattern came to a foundry, from which a good man could make but six pieces in a day. The foundry foreman wanted it altered so as to lessen the risk of moulding, and shorten time. At last it was done, and ten pieces were easily moulded in a day, and the percentage of loss reduced from 10 per cent. to 1 per cent. in an order of 500. Then many times a moulder is forced to spend ten or fifteen minutes in securing some disturbed place in every mould from some pattern, which could be remedied for all time by fifteen or twenty minutes work in pattern shop. This 15 or 20 minutes time, or any time, as to that matter, is never measured by dollars and cents in pattern making, or, if it is, I never heard of it, while in the foundry the bookkeeper, shipping clerk, and gate keeper can tell just how much castings should cost per pound, because their cost can be compared to prices prevailing in other foundries. That is one, and I believe the principal reason why the foundryman wants good patterns with liberal draft, parted where it will be the most convenient for the moulder, made in proportion so they will keep in truth in the casting and be free from such undue strain as will cause cracking. This he wants not only that he may do his work expeditiously, but do it sure, and that the casting will be a thing of beauty, without tool marks when done. The absence of criticism as to the effect the way pattern making is done has on the cost of work in the foundry has a tendency to make the pattern maker indifferent as to his work, so far as relates to the cost of moulding. That there are exceptions to this I am well aware, and it has been my good fortune to meet with pattern makers who would accommodate in this respect in every way possible, but it has also been my misfortune to find the mass of pattern makers totally indifferent, and what is stranger still, superintendents and proprietors can seldom be brought to realize that strongly built, generously drafted patterns that will mould easily and surely, mean reducing the cost of castings from $\frac{1}{8}$ to $\frac{1}{4}$ cent per pound, and provide for superior work.

Without dwelling too long on this subject, I should like to add, that sound and clean castings are more certain from patterns that draw well than from those where mending of moulds must be resorted to. It is generally impossible to replace disturbed parts of a mould so that the iron will lay quiet when poured.

I put myself on record as asking for all the draft it is practicable to give a pattern without disturbing some vital part. There is only draft enough to a pattern when you can't give any more. L. C. JEWETT.

That Piston Explosion.

Editor American Machinist:

I recently read in the AMERICAN MACHINIST an account, by J. H. Greenwood, of a curious explosion in a hollow piston. I think you published an account of a similar case some time ago. I am not an expert in such matters, but I should think that in case water had got into the pistons, that the oxygen of the water would combine with the iron of the piston, and that the hydrogen liberated in that case might form an explosive mixture with the air in the piston. STUDENT.

Melting Iron.

Editor American Machinist:

I am running a cupola that we put up six months ago. The most fuel I ever used was one to seven, and I am now melting with one to eight. I believe in using all the fuel required to melt good iron, but I do not believe in wasting it.

The cupola I am running is 48″ in diameter, of shell, 34″ inside of lining, 9 feet to charging door; double charging doors, 30″ high by 30″ wide in circle; double bottom; the wind box, $7\frac{1}{2}$″x$7\frac{1}{2}$″; eight tuyeres, 2″x6″; the main blow pipe is 10″. The wind box is cast instead of sheet iron, as most of them are. Our pattern maker made the pattern in a short time by cutting out segments and nailing them together. In place of making an expensive core-box, I made the core with a sweep. The four sections were put together with bolts, the joints being left open $\frac{1}{4}$″, and filled with lead after the pipe was put in place. The faces of tuyeres and doors are planed, making everything air-tight.

The blower I use is a Sturtevant No. 5, running 3,200 revolutions per minute. It runs faster than I would like to have it. When a blower is run too fast it strains the belts too much, and they either slip or break. The blast is steadier with blower running 3,000 than it is running 3,200. The blower sets thirty feet from cupola. The main pipe is 10″ diameter, and the two pipes entering wind-box 7″. I was obliged to use two elbows in order to make the connection. When elbows are used they are generally too small. While I use a 10″ pipe, the elbows are 12″.

In preparing the cupola, I always make it a point to be on hand to see whether the melter has it picked out and mudded up in good shape. There is danger of getting too much clay in as well as not enough. If there is too much clay put in, so that it projects beyond the brick, it is liable to peel off and cause a great deal of slag. I have a small fire built in the cupola every day after the bottom is put up. Some may think this is a foolish idea, but it does not cost anything to try it, and I think those who do so will find the lining will last longer and that they will

not be troubled with so much slag. The amount of sand to be put in at the bottom depends on the height of the tuyeres. The tuyeres in my cupola are 14″ from base. I have used them as low as 12″, but for coke I prefer to have them higher.

I omitted to state how I prepare the clay. In some foundries they use fire clay, weakened with sand. I use common clay, mixed with the burned sand that comes from the castings. It is hard to mix, but makes a good lining. The sand prevents the clay from cracking, and it stands fire equal to fire clay.

I start the fire at 3:45 P. M.; as soon as it is ready for charging, which is at 4:15, I close all the tuyeres and peepholes, so as to shut off all draught. Our heats have been all winter from 7,000 to 7,500 pounds. The fuel used on bed is 300 pounds coke and 200 pounds coal. I divide the iron into eight charges, 900 pounds to a charge. The fuel used for every charge is sixty pounds, except where the heat is over 7,200 pounds and not over 7,500 pounds; then I make the last two charges a little heavier, and add fuel accordingly. The blast is put on at 4:45, and the bottom is usually dropped at 5:30, which is just forty-five minutes from the time the blast goes on. It takes from six to eight minutes for the iron to begin to melt after the blast is put on.

In charging, I am careful to have the iron put in just as close as it can be put, to prevent the heat from escaping.

I have seen melting done in a great many different ways. Some melters light their fires two or two and one half hours before they put the blast on, and they build a cobblehouse with the iron, or throw it on with their eyes shut, thus leaving holes for the heat to escape.

Just now I am running lighter heats. For the last two weeks our heats have been about 6,300 pounds. By charging the same, and by using the same amount of fuel on the bed, it would take more fuel, proportionately, to melt this heat than it did to melt the first heats. By experimenting a little, I found I could leave off fifty pounds coke from the bed, and melt the iron hot enough to run the work. That leaves me 250 pounds coke and 200 pounds coal in bed. Then I charge the 6,300 pounds iron in seven charges, which is 900 pounds to the charge, with sixty pounds coke between every charge, which make 810 pounds of fuel to melt 6,300 pounds of iron.

The first 1,500 pounds of iron is run into mower wheels. These wheels have wrought iron spokes in them, and the rims have to be poured first to give them a chance to sink before the hub is poured. We have a light seat, and also a light gear cover, and several other pieces that take hot iron, and we have no trouble in running them.

For the benefit of David Spence (AMERICAN MACHINIST, April 5) and all others who are using such a large quantity of fuel, I would advise them to use some coke in the bed, say the same amount that I use in 34″ cupola. Three hundred pounds coke and 200 pounds coal in a 32″ cupola will melt iron hot enough for any casting. Then charge 700 pounds iron and sixty pounds coke, and so on. If their cupola is in any kind of order, and the iron charged properly, and blower in good order, I will warrant them iron hot enough for anything. That is a better showing than that of David Spence. But I don't wish to criticise anybody. All I wish to do is to convince him that there is a better way to melt with less fuel than he is using.

I have heard a great deal about a cupola that is made in Detroit, Michigan, with which melting as high as one to ten and one to eleven is claimed. If any reader of the AMERICAN MACHINIST is using one, I, for one, would like to hear from him. I know large shops that are using the Detroit cupola, melting from thirty up to seventy tons. What I would like to know is if they can melt a heat of three or four tons with one to ten. If it can be done, it would pay any firm to get a cupola of that kind. J. OTT.

Grinnell, Iowa.

Tool Arrangement in Machine Shops.

Editor American Machinist:

Did you ever notice how, in some shops, there seems to be a "slight misunderstanding" between lathes, planers, and other machine tools collectively, and that most useful of tools, a vise, singly? In such shops, the workman's ingenuity is taxed to the utmost to keep from going around three or four machines to the bench, and men sit or contort themselves into various shapes in a vain attempt to make a clamp out of their legs and some handy (or unhandy) chunk of iron or much-abused car wheel hub. The result is wasted time and a final trip to the vise. Perhaps a few figures will make this clear to those who "don't see it" just now.

In one shop where I noticed it, there were 23 machine tools of various kinds, each tool run by a man or boy; wages varying from 75 cents to $3 per day, and averaging $2.18 per day. The work was mostly jobbing work, and many trips had to be made to the bench to unscrew something or chip something else. The longest distance traveled was 65 feet, the shortest 12 feet, and the average 44 feet, as the small lathes were farthest from the bench, and there were 12 of them. The total distance traveled in one day by these men, from actual count, was 20,240 feet. In 300 working days this would amount to 1,150 miles. Supposing each man to walk at the rate of 3½ miles per hour, such a distance represents 328½ hours' work, at 21.8c. per hour, or $81.61. Perhaps it is needless to remark that $81.61 would pay interest on quite an extensive bench and several vises. HERBERT S. WILSON.

Kalamazoo, Mich.

Another Explosion in a Pump Plunger.

Editor American Machinist:

The following quotation from a letter written by Mr. G. Dennett, Engineer Salem Water Works, to myself, following the communication from Mr. J. H. Greenwood in your issue of May 17, may not be without interest:

"It is a singular coincidence. My remarks in the log of 7th April, 1884, *i. e.*, last month, reads: Overhauling water ends of No. 1 engine, removed bonnet of 'right' plunger, and found it full of water and *under a pressure;* found the 'left' plunger empty, but containing an explosive gas which did explode when 'Mark' inserted a lamp to examine the inside. Result: Burned hand, singed eyebrows and hair. What was it?"

My attention was called to this log remark yesterday morning by the assistant engineer, Mark Dugan, who handed me his copy of AMERICAN MACHINIST of May 17, with the remark and exclamation: "By George! I got off a deal better than the fellow at the Zanesville water works, anyhow!"

In 1874 I thoroughly overhauled this No. 1 engine—*i. e.*, ten years ago—at which time I found one plunger solid full of water, the other half full. I related this circumstance to Mr. Henry R. Worthington at the time, and he requested me to be particular that those joints were right. I did so, and until this 7th of April they were not disturbed. An unusual "ram" in "cushioning" the day before on one side of No. 1 raised the question. So I proceeded to uncover. We removed nuts, and on starting the joint with steel wedges, an inky colored water was ejected under a considerable pressure, as a ruined shirt-front will attest. This plunger was full of water. Upon removing the bonnet of "left" plunger, nothing unusual occurred till Mark had gone to the basement and returned with the open lamp, when, as the log says, the partial explosion took place, much to Mark's disgust, for he had christened No. 1 engine "O'Donovan Rossa."

It is a fact, if not generally understood among users of this class of pumping engine, that Mr. Worthington in its invention designed, and so proportioned his "hollow plunger," that its displacement of water should "float" it, thus preventing gravity from wearing the annular packing ring through which it moves, and adding to its friction.

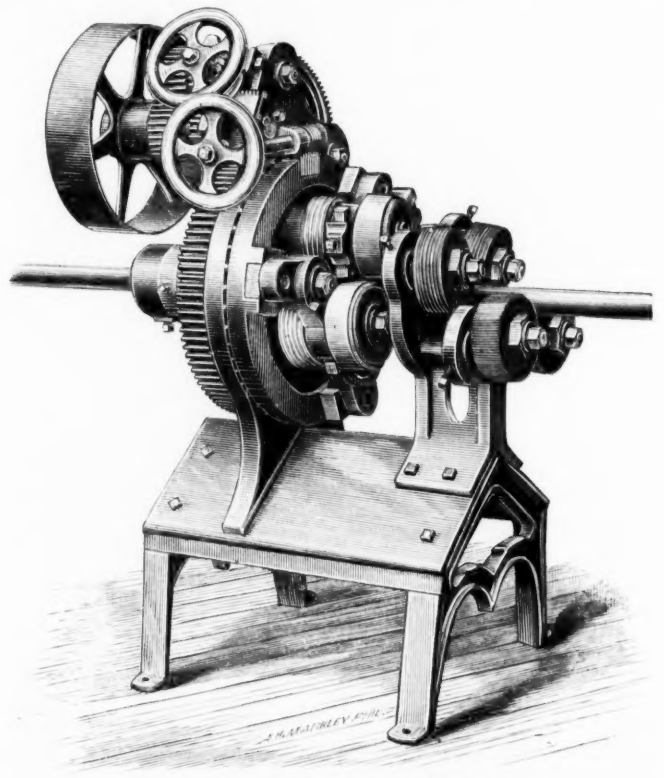
The mud, color, and smell in our case is as described in Mr. Greenwood's article. It is a strange coincidence that his and our experiences should have come so close together.

J. G. DENNETT.

The explanation would seem to be that in both cases the water found its way through the interstices of the metal from the outside to the inside of the plunger, carrying with it of course, more or less of organic matter.

The conditions then consist of a hollow cast iron plunger, having, in common with all iron castings, free graphite in its composition; atmospheric air; and water, with its contained organic matter. This water being constantly agitated in the inside of the plunger, certain chemical changes are undergone, by which the oxygen of the contained air, united with the graphite (carbon) and with the decomposing organic matter, thus forming new compounds, which will account for the mud in the plunger. There will also be present in the inclosed space a considerable quantity of carburetted hydrogen gas, which requires only a proper admixture of atmospheric air and fire to produce an explosion. WILLIAM M. BARR.

Brooklyn, N. Y.



THE OTTO TUBE CLEANING MACHINE.

"A Curious Explosion."

Editor American Machinist:

In reply to J. H. Greenwood, in your issue of May 17, I believe the explosion was caused by hydrogen gas, generated by the action of the water which leaked into the plunger. This water uniting with the iron formed oxide, the oxygen of the water uniting with the iron setting hydrogen free. A good deal of this action would be necessary to produce the effect described, because hydrogen constitutes only about one-eighth of water, by weight. The blue mud was probably an imperfect oxide of iron, containing carbon from the cast iron, which gave the offensive smell. Five years would probably do all this work, for the chemical action referred to is work. Upon opening the plunger and applying a light there was a small cannon, with a man for the projectile. L. C. R.

The Otto Tube Cleaning Machine.

The machine shown in perspective on this page is a tube-cleaning machine, invented for cutting off the scale that forms on tubes where hard water is used. The scale often adheres so tenaciously that much difficulty has been experienced in cleaning the tubes, and the operation has generally been performed in the most perfunctory manner. This machine consists of a frame carrying a complex arrangement of rollers which, being actuated by properly arranged gearing, revolve around a straight cylindrical space through which passes the tube to be operated upon. Some of the rollers have rubber faces and they are made to move in an angular direction, so that their action draws the tube into the machine. Other rollers carry cutters on their peripheries, and they do the work of cutting off the scale. Some of the cutting rollers have their teeth set lengthwise of the tube, while others are set at right angles, and the arrangement is such that by the time a tube passes through the machine the whole of its outside surface has been subjected to the action of a cutter's edge.

An ingenious feature about the machine is the simple and effective manner of changing the diameter of the space through its axis so that tubes of different diameters may be operated upon. The casting that carries the rollers consists of two plates, one being movable. Revolving this so-called adjustable ring, which is done by a worm gear on a shaft operated by a hand wheel, draws apart one-half of the rolls from the other half, or advances them toward each other, if that is desired. Connected with this feature is an arrangement for permitting the rolls to spring apart should the scale be too hard to cut, this precaution preventing damage to the tube. By means of a two-clutch pinion operated by a hand wheel, the machine can be made to run in either direction, a plan which obviates the use of a countershaft. The writer had an opportunity of watching one of these machines at work, and it cleaned the tubes rapidly and effectually. The machine is made by Pedrick & Ayer, proprietors of the L. B. Flanders Machine Works, 1025 Hamilton Street, Philadelphia, Pa.

A Cure for Steamed and Frosty Windows.

All engineers know what a nuisance a steam or frost covered front widow is in cold weather. Now, here is a *kink* I have used successfully for several years, where it is so cold a damp hand will stick to the chain of the fire door on fair days, let alone bad ones. A very thin coat of glycerine applied on both sides of the glass will prevent any moisture forming thereon, and will stay until it collects so much dust that you cannot see through it; for this reason it should be put on very thin. If used on a looking glass you can shave yourself in an ice-house and the glass will not show your breath. Doctors and dentists can use it on small glasses with which they examine the teeth and throat, and will not have to wipe them off at all. Surveyors can use it on their instruments in foggy weather, and there is no *film* to obstruct the sight. In fact, it can be used anywhere to prevent moisture from forming on anything. It does not injure the usefulness of field glasses, etc.; in fact, a small drop of pure glycerine in a small hole in a sheet of brass makes a good lens for a small microscope. I first saw this used on a steam gauge glass on a Sound steamer where the gauge leaked inside. GILLCRANK.

The D. & R. G. Ry. keep two air pumps at work in their back shops at Denver with which they test all pipe work, pops, gauges, etc., and when an engine is ready to come out they put 60 pounds of air in the boiler and run her out into the yard before she is fired up at all. G.

Laying Out Link Motion.

By J. G. A. Meyer.

FOURTH PAPER.

Problem 6—Fig. 9.

To find the position of the center of lifting shaft and the length of its arms.

In the last problem we found the point of suspension of the link, so that it will cause the valve to cut off equal portions of steam when the piston stands at half stroke. It now remains for us to find the position of the lifting shaft and the length of the lifting shaft arms, so that the greatest equal amounts of steam will be admitted alternately at each end of the cylinder. Here a little difficulty arises which needs explanation, so that our construction may not seem inconsistent to the reader. It would be an easy matter to place our lifting shaft to accomplish the object just stated, but if we do this the lead will not be equal at each end of cylinder when the piston is at full stroke. Again, if we locate our lifting shaft in such a manner that equal lead will be obtained, then the maximum cut off will not be equal, but the difference will be comparatively so small that it will not injure the working of the engine. This small difference of the maximum cut off is therefore considered among practical men of little or no importance, but it is always considered good practice to have an equal lead at full stroke. Let us therefore adjust the lifting shaft to obtain an equal lead, and allow us to consider the maximum cut off to be equal when the lead is equal at full stroke.

For this problem we have to combine all the foregoing problems. Through the center C of axle draw the horizontal line $A\ D$, and the line $K\ L$ perpendicular to it. Find the positions of crank at full and half stroke, as per Problem 1. Locate the rocker, draw the center line of motion $C\ T$, and amount of offset in lower rocker arm, according to Problem 2. Next, locate the relative positions of eccentrics when the crank stands at full and half stroke, as explained in Problem 3. Then, with a radius equal to the correct length of eccentric rods, as explained in Problem 4, draw

From the point x as a center the arc $x_1\ x_2$

"	y	"	" $y_1\ y_2$
"	$\frac{1}{2}x$	"	" $\frac{1}{2}x_1\ \frac{1}{2}x_2$
"	$\frac{1}{2}y$	"	" $\frac{1}{2}y_1\ \frac{1}{2}y_2$
"	a	"	" $a_1\ a_2$
"	b	"	" $b_1\ b_2$
"	$\frac{1}{2}a$	"	" $\frac{1}{2}a_1\ \frac{1}{2}a_2$
"	$\frac{1}{2}b$	"	" $\frac{1}{2}b_1\ \frac{1}{2}b_2$

Locate the points $\frac{1}{2}B_3$ and $\frac{1}{2}F_3$, indicating the position of the center of lower rocker-pin when steam is cut off at half stroke; find the points $x_1\ x_2$, indicating the positions of the point of suspension when the link is lifted into the position to cut off at half stroke, as explained in Problem 5 and shown in Fig. 7.

Now, in order to find the position of lifting shaft and length of arms, we must find four more additional points; first, the position of the point of suspension of the link when the piston is at full stroke forward end of cylinder and the crank-pin at F, the valve having $\frac{1}{16}$ of an inch lead, and the engine moving forward as indicated by the arrow point 1; also the position of the point of suspension of the link when the piston is at full stroke at the opposite end of the cylinder, valve $\frac{1}{16}$ inch lead, and engine going in the same direction. To find these two points we must know the corresponding position of the center of lower rocker pin. In Fig. 8*a* (May 24) we see that when the piston is at full stroke forward and valve with $\frac{1}{16}$ inch lead, the center of valve is $\frac{3}{16}$ of an inch in the rear of the center line of exhaust, and consequently the lower rocker pin will be $\frac{3}{16}$ of an inch in front of the line $Q\ U$. In the same manner we can show that the center of lower rocker pin will be $\frac{3}{16}$ of an inch in the rear of the line $Q\ U$ when the piston is at the opposite end of the cylinder.

Let us now locate the positions of the lower rocker pin in Fig. 9 by drawing a line parallel to and in front of $Q\ U$, with $\frac{3}{16}$ of an inch between them; this line will intersect the arc $R\ S$ in the point F_3, and this point will be the center of lower rocker pin when the piston is at full stroke forward. Draw another line $\frac{3}{16}$ of an inch in the rear of $Q\ U$ and parallel to it; this line will intersect arc $R\ S$ in the point B_3, and this point will be the center of rocker pin when the piston is at full stroke in the rear end of the cylinder. Now place the paper template with the line $e\ e$ below the center line of motion $C\ T$, the point f_1 on the arc $x_1\ x_2$, the point f_2 on the arc $y_1\ y_2$, and the link arc $c_3\ c_4$ just touching the point F_3, and while in this position mark the point X of the template on the paper, which can be done with the aid of a needle, and indicate the point on the paper by x_3. This point will be the position of the center of saddle pin when the piston is at full stroke in the forward end of the cylinder, the valve having $\frac{1}{16}$ inch lead. Again slide the template along until the point f_1 is on the arc $a_1\ a_2$, the point f_2 on the arc $b_1\ b_2$, and the link arc $c_3\ c_4$ in contact with the point B_3; mark the point X of the template on the paper and indicate this point by x_4. This point will be the position of the center of saddle pin when the piston is at full stroke in the rear end of the cylinder, the valve having $\frac{1}{16}$ inch lead. Secondly, to find the position of the point of suspension of the link when the piston is at full stroke in the forward end of the cylinder, valve having $\frac{1}{16}$ of an inch lead, and the engine moving

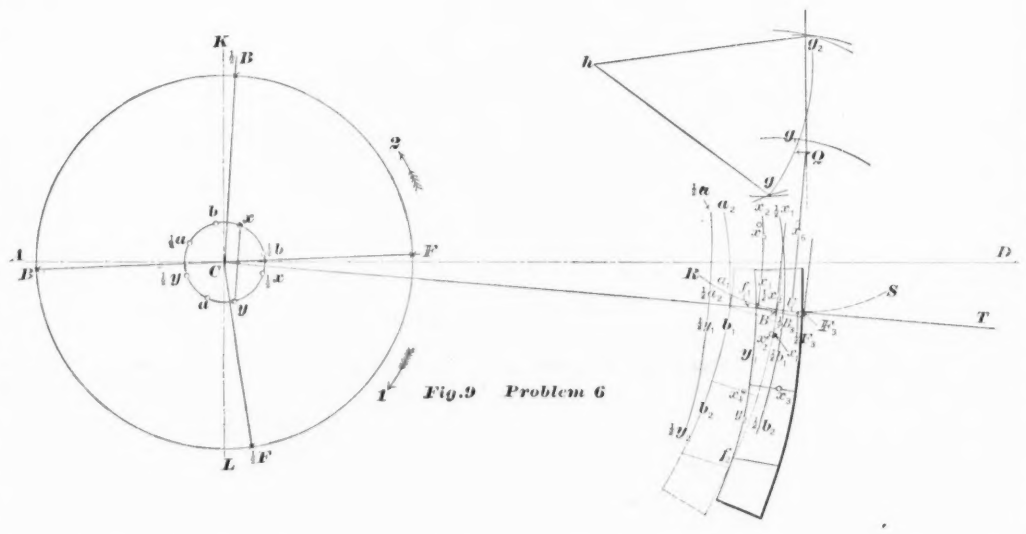


Fig. 9 Problem 6

backward, as indicated by the arrow point 2; also the position of the point of suspension of the link, when the piston is at full stroke at the opposite end of the cylinder, valve $\frac{1}{16}$ of an inch lead, engine going in the same direction. For this purpose, slide the template along until the line $e\ e$ is above the line $C\ T$, and f_1 in the arc $a_1\ a_2$, the point f_2 in the arc $b_1\ b_2$, and the link arc $c_3\ c_4$ in contact with the point B_3; mark the point X on the paper, and indicate this point by x_5. This point will be the position of the center of saddle pin, when the piston is at full stroke in the rear end of the cylinder, valve having $\frac{1}{16}$ of an inch lead. Again slide the template along until the point f_1 will be in the arc $x_1\ x_2$, point f_2 in the arc $y_1\ y_2$, and the link arc $c_3\ c_4$ in contact with the point F_3; mark the point X on the paper, and indicate this point by x_6. This point will be the position of the center of saddle pin (or the point of suspension), when the piston is at full stroke in the forward end of the cylinder, valve $\frac{1}{16}$ of an inch lead, engine moving backward. Now, once more, with the point x_3 as a center, and with the length of the link hanger as a radius, describe an arc; and with the point x_4 as a center, and the same radius, describe another arc. These two arcs will intersect each other in the point g. Again, with the length of the link hanger as a radius, and the points $x_1\ x_2$ as centers, describe two arcs intersecting each other in the point g_1, with the points $x_5\ x_6$ as centers, and with the same radius, describe another two arcs intersecting each other in the point g_2. Lastly, through the points $g\ g_1\ g_2$, draw an arc. The center h, from which the arc has been described, will be the center of the lifting shaft, and the radius $h\ g$, or $h\ g_2$, will be the length of the lifting shaft arms; that is, the length of the two arms, to which the link hangers are attached; the length of the other lifting shaft arm, to which the reach rod is attached, is made to suit the other details of the engine.

When the admittance of steam ceases at the same time that the piston has reached the half stroke, the practical man would say "that the valve is cutting off equal at half stroke." When the greatest equal volume of steam is admitted alternately in each end of the cylinder, the valve is said to be cutting off equal when the link is in full gear.

It is always conceded among engineers that when the link motion is adjusted to cut-off equal at half stroke, and also to cut off equal when the link is in full gear, that equal volumes of steam will be admitted alternately when the link hangs at any intermediate point.

If now we examine problem 5, we find that, to obtain an equal cut-off at half stroke, it is necessary to find the proper position of saddle pin.

Again, if we examine problem 6, we find that, in order to obtain an equal cut-off when the link is in full gear, also an equal cut-off for any point between full gear and half stroke, we have to determine the proper position of the center of lifting shaft and the correct length of its arms.

Lastly, if we examine the first four problems, we find them simply to be preparatory problems.

According to promise, we will draw attention to those points which have been, and others which have not been, approximately found. Problems 1, 2 and 3 are theoretically correct. In problems 4, 5 and 6, the use of the template will not be admitted for theoretical reasoning; but, if the construction is made with absolute accuracy, the result will be theoretically correct.

Elements and Manufacture of Foundry Facings.

By Thos. D. West.

SECOND PAPER.

In this country the sea coal used in our foundries is principally derived from the mining regions of the Youghiogheny river and the Cumberland districts, and is selected for its freedom from slate and sulphur, and its gas-bearing qualities. The quality of sea coal blacking is less variable than that of any other blacking made, simply from the fact of its not being mixed with any other substances. Sea coal being mixed in with the sand, divides the particles, or fusible element of sand, and what it don't divide it emits its gas among. The hydrogen and carbon sea coal contains prevents, to a degree, sand fusing. There is a limit to the percentage of sea coal that should be mixed with sand. When more than one of sea coal to six of sand is used, unless the surface of the mould is well coated with good blacking and the metal poured dull, there is in the heavy body of metal moulds much danger of the surface of the casting being more or less streaked or veined; thoroughly mixing of facing sand, will, to a large degree, prevent this defect. When iron is poured into a mould faced with sand containing sea coal, there is much gas generated. This gas if not driven off by pressure, forms more or less of a cushion between the surface of the mould and metal. This cushion often prevents the iron from running into the corners and edges of moulds, and also often causes cold shuts and smooth concave indentations in castings. Moulds having been poured with dull iron, although the casting may be heavily proportioned, will often present some of the above defects. In faced moulds, more or less of a gas cushion is raised, and, according to the amount of pressure and the fluidity of the metal, the faster this cushion is destroyed. When strong facings are used upon thin castings, or those poured dull, the metal often becomes set before this cushion is all destroyed. Sometimes sea coal causes the surface of castings to be covered with a coat of what might be termed coal soot. This, to occur to any great extent, requires certain conditions that seldom happen to combine.

In mixing facing to assist in obtaining a full run and smooth-skinned casting, the moulder has often many points to consider. Many moulds are made that require two or three different grades, and not only is the proportion and position of parts to be considered, but time of pouring, and intended fluidity of metal as well. The amount of sea coal to use, according to conditions and suggestions upon the subject, having in previous writings been commented upon, the reader will excuse details being here given.

As Lehigh, coke, graphites and gas-house carbons form so great a factor in assisting the peeling of castings, a short history concerning them may be interesting. Lehigh is simply a fine quality of Lehigh coal, chiefly obtained from the anthracite districts of Pennsylvania. It is essential that only the best quality should be used, as poor Lehigh containing slate and what is known as "nigger head" would not contain the amount of carbon required to make good blacking.

Coke blackings are principally made from "Connellsville coke," it being selected on account of its fixed carbon being as high as 90 per cent.

Carbon, or gas-house retort slag being a pure carbon, would, were it not for its hard refractory nature be more extensively used. Its hardness makes it difficult to be ground and bolted as fine as is necessary to make good blacking, therefore when used it is mixed with minerals that will overcome to a degree its refractory nature and give it cohesion, which it lacks in a much greater degree than either Lehigh or coke. To give these refractory substances, Lehigh, coke and carbon, cohesion, the class of material used has much to do with the peeling quality of the blacking. The more carbon, the ingredient used to give cohesion, contains, the richer and better the blacking to withstand heat. As leads contain the highest cohesive heat element, and is such an important factor in facings, and blackings, a few lines upon its nature may not be out of place. A very fine grade of close grained graphite or lead, and one extensively used, comes from Bohemia, Austria. Not only is this lead used in blackings, but also enters to some extent into the manufacture of stove polish. Probably the most expensive lead used is that which is mined in the Island of Ceylon. In its crude state it looks like bright chips of burnished silver, from which fact it is commonly called silver lead. This is a very useful article, not only for mixing with blacking for green, dry sand and loam work, but is also a splendid article to dust, in a dry state, over the surface of black loamed moulds, as it greatly assists the sleeking of the mould, and peeling of the casting. This lead is also ground for electrotyping purposes, and is extensively used as a lubricator for cylinders, etc. While mentioning the leads produced abroad, America has also some mines of note. One especially, near

Ticonderoga, N. Y., produces an excellent article, which is extensively used in making lead pencils. North Carolina produces quantities of lead, but as it is largely mixed with clays, hornblende and other foreign substances, it is not of much value. Eastern Pennsylvania has several mines, but as the lead requires so much treatment in cleaning, it is not very profitable to the producer. Tennessee has also vast beds of leads, more or less mixed with clays. Nova Scotia produces a lead, which on account of its hard flinty nature has so far been but little used. The leads of Ceylon and Europe, surpassing the home product, are therefore the ones chiefly used.

Charcoal, to make a good dust, requires to be made from hard maple wood, and burnt with great care. Soft, or any stringy-grained wood, is not adapted for making charcoal facings. Stringy-grained wood preserves all its stringy nature when charred, and makes a harsh powder when bolted. Soft wood charcoal is even worse, as its lacks the body necessary, being so light it will float or wash.

A product not yet mentioned, and one sometimes used in foundries and mixtures of blackings is soap stone. This is found in many of the States, and is by some foundries used quite extensively, while others condemn its use on account of the light color or skin it gives to castings.

Its a well-known fact that although moulders use blacking every day, but very few have the least idea of its manufacture or properties which cause it to peel castings.

This article may be effective in drawing attention and study to a material which before it can be intelligently purchased or used, requires some knowledge of its constituents and manufacture.

The Boiler Explosion at Gouverneur, St. Lawrence County, N. Y.—Its Lessons to Steam Users and Boiler Builders.

BY GEORGE MARSHALL.

A visit to the scene of the above occurrence, and an investigation into its causes, fully corroborate the statements made in former papers, as to the importance of a more intimate knowledge on the part of steam users of the technical names and meaning of the different brands of iron used in the construction of steam boilers, and on the part of boiler builders in personally superintending the quality of the work turned out by them or by their orders, and in using better materials than are frequently used in that important machine, "the steam boiler."

The facts obtained by the evidence of experts, in their sworn statements before the coroner and jury, as well as the silent evidence of the iron of the boiler, demonstrated beyond question that the iron used was of the poorest quality used in boiler construction, the workmanship the cheapest to be possibly obtained and utilized in boiler building, and also that the parties ordering the boiler had been unintentionally deceived by those who performed the work, from the statement having been made "that the iron used was to be of best C No. 1 quality, and first-class in every respect." While I do not think there was any intention on the part of the builders to deceive their customers in making such a statement as that given, yet I think it would have been prudent in them to have given more definite information as regarded the difference in the quality and brands of iron generally used, and a figure corresponding to the extra cost of the same boilers made of better material. The object of this paper not being to prejudice public opinion in regard to future proceedings, or to give a one-sided view of the facts as presented to the writer, it will be best, perhaps, to clearly and concisely state the full facts, regardless of theories, and allow your readers to determine for themselves as to the responsibility of the accident, and to place the blame where it properly belongs. The boilers were ordered by the Whitney Marble Company, of Gouverneur, N. Y., who own a marble quarry in the vicinity of that beautiful village, and also have (or had) a mill for dressing and finishing the rough stone. They were each fifty-four inches diameter, and had sixty-eight tubes three inches diameter and twelve feet long. They each had a steam dome about thirty inches diameter, and the same height, with wrought heads in dome, which while amply were yet poorly braced, as the braces were of flat iron, $\frac{3}{8}''$x$1\frac{1}{2}''$, single rivet in each end that was in the dome. The heads of boilers had two bars of T iron above the flue line for braces, and from the T iron three braces (I think) extended from head to head. The iron used in the shell of boilers was that known as "Refined" quality, formerly known as C No. 1. This brand, since the introduction of that brand known as "Shell," is but seldom used by reputable boiler builders, as it is pretty generally known by them that the quality is in reality hardly equal to that formerly known as C No. 1, and the latter at present is simply selected tank iron. Whether this deterioration of quality was or was not known to the parties who took the order, I am not positive; but I believe, from the character of the firm, that they were not aware of the fact. The mode of riveting was that usually known as "hand snap," and is of such a quality that cheap labor can be, and is, generally employed in this method of driving, as it requires but a few hours' experience, with little instructions, to become an expert with the snap tool. The caulking was also of the cheap quality, but that this was so need not give surprise when it is known that the foreman of the shop built the boilers by contract with his employers, and they lacked mechanical education sufficient to fully distinguish between good and bad work. The shells of boilers extended beyond the front-heads, and formed a smoke chamber, from which the smoke passed to an iron chimney used for both boilers.

The shells were $\frac{5}{16}''$; tube-heads about $\frac{7}{16}''$, and dome and dome-head, $\frac{3}{8}''$ thick. On top of shell, inside of dome flange, were two holes of about nine inches in diameter, the object of which I suppose to be to prevent water being raised into dome and steam pipe, the hole for the latter being centrally located in dome-head. These two holes were not reinforced, and were for this reason an element of weakness and danger. The estimate made by the builders was, I believe, the only specification furnished, and this stated, as already mentioned, that the iron used would be of best C No. 1 quality, and the boilers first-class in workmanship. Ignorant of the real meaning and merits of that particular brand of iron, and fully believing that this meant the very best iron, the order was given for the work, no contract being made or signed by either party, each having confidence in and knowledge of the other. The boilers were delivered in the fall of 1883, set in position from plans furnished by the builders, the work of setting being superintended by an old employe of the building firm. The domes were connected together by means of the usual T's valves and pipes employed in such cases, and were arranged (so I understood) as to prevent a strain on domes by placing elbows in such places as to allow expansion on the connection. The feed-pipes were also arranged in good form, and were in no way obstructed in the performance of their work. Water columns, with glass water gauge, gauge cocks and steam gauge, were also provided by the builders; and these, together with the safety and globe valves in steam connection, were apparently of very good quality. A short time after the boilers were fired (I think two or three months) leaks were discovered around the dome flanges. The builders, being notified, sent men to make repairs, which consisted in caulking around the leaky flange, affording but temporary relief, as the same defects were noticed in a few weeks afterward, and again men were sent to make repairs. This was repeated for the third time, and attended with fatal results, in the explosion of one boiler, the entire destruction of the mill, and the death of two boiler-makers, the engineer, foreman of the drills, and two others employed in the mill at the time.

From the evidence and statements it appears that the foreman who built the boilers was discharged, a new man, probably an old workman but a young foreman employed, and a new era inaugurated of building the work without contract This new foreman accompanied the workmen on their ill fated visit, advised the cutting out of some rivets in dome flanges of both boilers and the introduction of stay bolt braces from head of dome to shell, but placed about three inches from periphery of dome. His instructions were carried out, and one boiler being completed was tested by having steam generated until a pressure of 110 lbs. was reached, this being considered sufficient. The other boiler was to have been tested in a like manner, but time pressing and the boiler makers being desirous of returning to their homes, and the steam from firing the boiler proving too slow, the connections were opened and the explosion followed.

There is no actual proof of the valves having been opened other than that said valves were open when found. The last seen of the condition of steam according to steam gauges, showed a pressure in boiler first tested of 95, and in the other of 35 pounds; this within 20 minutes of the time of the disaster.

So called experts were called and sworn, one of whom gave the initial point of rupture at the double riveted horizontal seam immediately under the dome on side of boiler, while two others gave the initial point as the bottom in immediate proximity to blow-off. One expert gave his opinion that the iron was overheated yet not burned; another that the tubes showed evidence of overheating, while a third swore that there was no evidence whatever of overheating in any part of the boiler. Both the builders of boilers and owners of mill were represented at the inquest by counsel, and the efforts of the latter were chiefly directed to throwing as much responsibility on the other side as was possible to do from the evidence of witnesses.

There was no advice given that I could learn of, or suggestions made by boiler builders or asked for by owners, as to the safety limit of pressure, and this is to be deplored under the circumstances, as it would perhaps have been the means of preventing the explosion and consequent loss of life.

The Coroner's jury were composed of the leading citizens of the village, some of whom are eminent mechanics and superintendents of local industries. Others were from the professions and commercial industries of the village. In all they were the most intelligent body of men I have ever seen acting as a Coroner's jury, and the Coroner deserves great credit for the discernment and judgment displayed in the selection of such men for such an important trust, when it is taken into consideration that the accident occurred about noon, and the remains of two of the victims had to be taken to an adjacent town for interment that afternoon. The verdict was in effect that the parties had come to their deaths by the explosion of one of the boilers at marble mill; that there was nothing in the workmanship or material responsible for the accident, the latter being caused by the opening of the valve of communication between the two boilers by some one unknown to the jury.

Much more could have been said in their verdict without conveying any more meaning, and from the evidence it was all the jury could do, as no one could prove who opened the fatal valve. From the position of bodies when found there can be little doubt that one if not both boiler makers were on the top of boilers when the accident occurred, and the engineer at or near the front of boiler, or in the vicinity of pump. The latter being supposed a fact, an effort was made to establish the theory that there was an insufficiency of water in the exploded boiler, and that the engineer was engaged in pumping at the time. This line of proof was abandoned, being unproductive in results. The point I wish to establish is that steam users as a class are entirely too ignorant of the technical meaning of trade names used in construction of steam boilers, and are too entirely confiding in the integrity of engine and boiler builders, relying on the reputation, or perhaps financial standing, of the firm rather than depending on expert superintendence of construction and intelligent understanding, by means of a specification of the meaning and quality of different material employed in construction. As a class, steam users do not read up on mechanical subjects. In this, as in all other reforms, education must be resorted to in order to accompish the desired result, and as there is no paper entirely devoted to steam users as a class, I trust the AMERICAN MACHINIST will throw the electric light of its columns on these and kindred subjects of such vast importance, not only to engineers and steam users, but to those who may be exposed to the disastrous effects of a steam boiler explosion.

Fast Train.

On May 8th a special train, consisting of two coaches, for the accommodation of Cornelius Vanderbilt, was run from Detroit to Cincinnati, passing the distance of 263 miles in five hours and thirty minutes. This gives an average speed of 47.7 miles an hour, without taking into account the loss of time in making stops for water, for change of engines and the slowing up passing through towns, and other causes of detention. The run was made over 61 miles of the Michigan Central Railroad track, and 202 miles over that of the Cincinnati, Hamilton & Dayton Railroad.

From Mr. Ralph E. State we have received some reliable particulars regarding the run over the latter road. He says: "Three locomotives were used on our road to make the run from Toledo to Cincinnati. The engine used on the first division was a Rogers. Drivers 5 feet diameter; cylinders 15x22 inches, and made 71 miles—Toledo to Lima—in 96 minutes. This includes three stops, as follows: At Weston the operator went to dinner and left the block against the train. They ran through $\frac{1}{4}$ mile, then backed up to have the operator take off the block. This delay lost ten minutes. Another stop was made at the Baltimore & Ohio crossing, where water was taken and the engine oiled. The third stop was made at the Nickel Plate crossing. Actual running time over this division 75 minutes, the distance being 71 miles.

"The second division run was made by a Grant engine, with cylinders 15x22 inches, and drivers 66 inches diameter. The distance of 71 miles was made in 93 minutes, after stopping for four crossings and slowing up through five towns.

"The third division was run by a 'Cincinnati shop' engine, with cylinders 16x24 inches, and drivers 66 inches in diameter. The distance of 60 miles was passed in 69 minutes, which included the delay of five stops.

"No special effort, whatever, was made in the way of selecting good engines. The orders for the special were not given until late, and all the best engines were out on the road, and anyhow the train was too light for our best engines."

The train was run through all cities at a rate of speed complying with the ordinances respecting the speed of trains. From an inspection of the station reports we estimate that a good many individual miles were run in about 50 seconds.

Last winter proved unusually cold in Continental Europe, and a great deal of suffering was endured even in luxurious houses through defective heating arrangements. Consul Kiefer, of Stettin, perceived that the need of Germany was stoves made on the American plan. He now urges our stove makers to send specimens of their best heating stoves to Germany, and he anticipates that a good market can be found there for American stoves. All he thinks that is necessary is a beginning, when he feels sure the demand will increase rapidly.

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NEW YORK, MAY 31, 1884.

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Methods of Selling Machinery.

Sometimes it seems to be assumed that the best way to sell machinery is by making comparisons unfavorable to other manufacturers in the same line. This plan hardly ever proves a permanent success. Buyers are naturally enough interested in knowing the good qualities of what they are solicited to buy, but knowing these may be trusted to make their own comparisons. Argument in the way of comparative merit, however honestly meant, is generally looked upon as quite the reverse. Again it seems frequently to be taken for granted that representations quite beyond reason must be made, apparently on the ground that the buyer will make reductions anyhow, and that unless he has high figures to start with he will get his estimate of efficiency and superiority too low. These high representations may occasionally be the means of effecting a sale, but not generally. Most of those who are likely to buy, a steam engine for instance, if not experts in steam engineering have learned enough of the subject to know that there are a good many who build steam engines that cannot be improved upon one-hundred per cent., and it is a healthy sign that the number of those that are not pleased with assertions to that effect is increasing. They understand in a general way why the speed of a steam engine cannot be *perfectly* controlled, and are not likely to heed statements to the contrary. They know that any machine will wear out, is liable to break down under sufficient provocation, will need repairs, and that skill and judgment are required to properly handle costly machinery, and assertions to the contrary do not count for anything. Perhaps it would be more nearly correct to say they do heed such statements, and take account of such assertions, by reasoning that misstatements in one respect are likely to be accompanied by misstatements in other respects, which would certainly be a logical if not always a correct conclusion.

There is probably in these extravagant representations not so much an intention to deceive, as there is a desire to keep up with others in this respect, but those who are the most successful in building up permanent business do not resort to them. There are many, and their number is increasing every day, who want to know exactly what they buy, and such get to deal with manufacturers who give them plain facts.

No conclusion that might be drawn from the foregoing will apply to those who sell stock in impossible inventions—steam engines that run without steam and boilers that make steam without fuel. They deal with another class and start to sell *humbug*, pure and simple, but because they are successful with the class with whom they deal, honest men should not assume that the people generally have come to demand being humbugged. Quite the contrary is true. There will always be enough to invest in a railroad to the moon, or in a transatlantic balloon line, but those anxious to do so are not in the majority, and it is a mistake for honest dealers to assume that they are forced to adopt the methods by which such stock is placed.

Some weeks ago a union of trades unions was organized in Rhode Island. Among other declarations of purpose they put forth the following:

We favor the self-employment of labor by co-operative association, as complete independence can only be obtained when the laborer is no longer dependent on other individuals for the right to work; and especially do we recommend that whenever trades intend striking for the accomplishment of any just purpose, if the funds of the organization will allow it, the resistance, instead of being passive, should become active and aggressive, by using the funds productively instead of unproductively.

The plan of co-operation in productive labor is one that workmen should adopt, rather than to strike. As a usual thing it requires less sacrifice than a long and idle contest with employers over the rate of wages. During such contests with employers the savings of workmen are absolutely lost without hope of return. In a co-operative venture, even if the original investment is lost, success may be reached if the business can be maintained. The "active and aggressive" resistance of a co-operative industrial enterprise is of a kind that can well be borne, provided it relates only to competition. It is the privilege of every one to start industrial competition. Success, however, depends upon certain business principles, which must be observed by workmen who co-operate as well as by those who are accustomed to own and control productive enterprises.

In this issue we finish a series of four articles on "Laying Out Link Motion," by Mr. J. G. A. Meyer, Chief Draftsman of the Grant Locomotive Works, Paterson, N. J. Mr. Meyer has stated his problems describing the method of laying out the link motion in a plain, simple manner. There is no expression in the articles that any ordinary machinist will have difficulty in understanding. Any machinist who will reproduce the cuts on a drawing board, and follow the explanations step by step, will experience no difficulty in learning how to lay out a link motion for any engine. We commend this as an excellent line of study to those desirous of comprehending intimately the link's action, and the principles of this form of valve motion.

Labor's Competition with Machinery.

While the present prolonged commercial crisis in Britain is inflicting hardship upon capitalists, the *Mechanical World* claims that workmen are the greatest sufferers, and that the prospects for improvement in the condition of British workmen are far from being reassuring. The application of machinery to every species of labor, it argues, is every day making the struggle for existence harder among mechanics. Just at the present moment large numbers of riveters are out of work, and every boiler and bridge works is besieged by men offering themselves for employment. A great deal of this surplus labor in the riveting trade is due to the improvement in hydraulic, portable, and riveting machinery. A riveting machine does the work of three or four men, who are thrown out of employment. Other trades are subject to similar influences, and the means of changing employment are so limited for skilled workmen in Britain that much suffering results from what is perhaps a benefit to the nation at large. The *Mechanical World* does not see that the workman's condition has been much improved by the development of labor-saving machinery, or that he has enjoyed his share of increased production resulting from improved methods. The millennium which the era of machinery was going to introduce is being pushed continually into the background.

While it may be true, as our contemporary argues, that workmen do not always get their share of the benefits resulting from the use of improved machinery, it is not true that they do not receive great material benefit therefrom. Improvements of the kind refered to have enabled the workman of to-day to live better than the man of unlimited means did a few years ago, measured by the comforts they are able to provide themselves with. The workingman of to-day works fewer hours, lives in a better house, dresses better, and is in every way better situated than the workingman of fifty years ago. That he deserves even more than he gets should not blind him nor our contemporary to the fact that he gets more than he did. It is only necessary to compare the condition of the artisan in a country where the most is made of labor-saving appliances—England, for instance—with that of the artisan in a country where but little use is made of such appliances—say China—to demonstrate that the argument used by the *Mechanical World* is not sound. At the same time we admit that the workingman is receiving none too much—not enough—of the advantages of cheap production. As a matter of fact, any violent changes by which a man is enabled to do the work of three or four men will *at first* operate unfavorably to the two or three that may be temporarily out of employment but in the end they will all profit by it. It would be better if there were no temporary derangement, but this derangement is the result of the working of a law that cannot be readily set aside.

The ocean-carrying business is so depressed in the North-eastern ports of England, that over one-fifth of the total number of steamers registered are laid up for want of remunerative freights, and matters are growing worse instead of improving. To such straits are ship-owners driven by the resulting closeness of competition, that mutual insurance clubs have proposed the expedient of paying premiums to the steamer owners who will keep their vessels laid up. This action is similar to that followed by associations connected with various American industries, who during seasons of depression maintain a fund to compensate the owners of works that will close, and thereby prevent ruinous over-production. Few of the best-managed steamboat companies have been able to pay dividends last year. This seems to be rather an untimely season for starting up American lines of steamers to compete with those already established. Yet the advocates of free ships would like legislators to believe that American capitalists are eager to go into this business, if they can only be permitted to buy their ships in Britain.

A lawsuit of considerable importance to employes engaged in railroad operating was lately decided by the Supreme Court of Wisconsin. An engineer was in the habit of running a train which had a certain meeting point. A new time card came out, which changed this meeting point to a station nearer the starting point; but the engineer did not receive the new card till he was ready to leave on the trip, and he did not study its contents. The result was that he passed the new meeting point and had a collision with the other train. The company discharged him, keeping back the pay due to help cover the damage done to its property. The engineer sued the company for his pay, and the courts gave judgment in his favor on the grounds that he ought to have been supplied with the new time card in time to study its contents. There is a practice common among many railroads of holding back their new time cards so that no one shall get them till the day before the day they go into effect, the result being that some of the trainmen do not see them till a day or two afterwards. This decision may stir them to the danger and responsibility of such a practice.

Clement E. Stretton, C. E., who has been prominently connected in England with measures for promoting the safety of railway operating, has recently published a pamphlet on railway accidents. Within a year the publication reached its third edition. The object of Mr. Stretton in the work is exceedingly commendable, being the enlightenment of the British public respecting the cause of accidents, and how they may be avoided. The principal remedy recommended for the prevention of railway accidents is the use of the best safety appliances in operating. He brings out clearly the efficacy of good continuous brakes as a means of preventing accidents, the Westinghouse automatic being his favorite.

Making a Toy Locomotive.

The press dispatches on the day of the recent Wall Street panic made the announcement that a mechanic in western New York had just completed a locomotive eight inches long, and the important intelligence was blazoned on every bulletin board in the commercial metropolis as prominently as the news of failures. The daily papers are not in the habit of devoting lavish space to mechanical matters; in fact, the average newspaper has not yet made the discovery that American mechanical industries are of any importance, so we concluded that the tiny locomotive that was receiving so much attention must reveal some stupendous discovery in mechanical science. But we

searched the item in vain for anything of value to the mechanical world. A man had devoted three years of his life, working ten hours a day, to the production of a toy locomotive, with cylinders $\frac{5}{16}$x1 inch, with every other part small in proportion. We cannot regard the feat of this mechanic as anything otherwise than wasted industry. The work produced is not so small as numerous daily operations in watchmaking, so it can have no value as a specimen of minute workmanship, and we do not see that anything about the construction of the engine adds a grain to the volume of human knowledge. The feat of making this engine is about equal to that of the maiden lady who devotes the labor of five years to the sewing of a patch-quilt, containing an amazing number of combined fragments. The tendency to produce work of this kind does not emanate from healthy conditions, and we do not desire to see its influence extending into the machinist ranks.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(220) E. M., Fall River, Mass., asks: How shall I calculate the proper position for the weight on a safety-valve lever? *A.*—You will find this illustrated in the AMERICAN MACHINIST of May 8, 1880.

(221) J. F. H., Arvon, O., asks: Is it safe to run a feed pipe from the pump about three or four feet under the boiler and return, the object being to heat the feed water? *A.*—The pipe might be so arranged, so that there would be no probable danger to life, but there is always the danger of burning the pipe some time, and causing delay and trouble. We should not recommend doing it. It is better to place pipe in the uptake, or where it will get heat that will be of no use in generating steam.

(222) J. C., Albany, N. Y., asks: Will you please give me a rule for proportioning flange couplings; that is, diameter and number of bolts, diameter and thickness af flange, etc.? *A.*—The following table, from Box, on mill gearing, represents good practice:

Diameter of Shaft.	Diameter of Flange.	Thickness of Flange.	Diameter of Boss.	Depth of Boss.	No. of Bolts.	Diameter of Bolts.	Diameter of Circle of Bolts.
Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
1	5	3/4	2 1/4	2	3	1/2	3 1/2
1 1/2	6 1/2	7/8	3 1/4	2 1/2	3	5/8	4 3/4
2	8	1 1-16	4 1/4	3	4	3/4	6
2 1/2	9 1/2	1 3-16	5 1/4	3 1/2	4	7/8	7 1/4
3	11	1 3/8	6 1/4	4	4	1	8 1/2
3 1/2	12 1/2	1 1/2	7 1/8	4 1/2	4	1	9 3/4
4	14	1 5/8	8	5	6	1	11
4 1/2	15 1/2	1 7/8	8 7/8	5 1/2	6	1	12 1/2
5	17	2	9 3/4	6	6	1 1/8	13 1/2
6	20	2 1/4	11 1/2	7	6	1 3/8	16

(223) W. J. W., Allegheny City, Pa., writes: I have been engaged in a little patent business. A friend of mine conceived an idea of holding and guiding horses by means of a mechanical contrivance applied to the nostrils, and I was to get it patented. I paid the attorney fifty dollars in advance (which was fresh). Well, the attorney finds out that the device is already patented, and he refuses to return me any part of the money; in fact, he claims I owe him five dollars. Is he right? *A.*—We do not know what agreement you may have made with your attorney. Some experience in such matters would lead us to have expected to pay five dollars for the usual short preliminary examination. If, then, the application had been made and rejected, we should be expected to have paid not to exceed forty dollars more—forty-five dollars altogether. This is on the assumption that it was a simple case, which it seems to be.

(224) F. S. H., Chelsea, Mass., asks: Will you inform me if there is an automatic water feeder for boilers, and if so where I can find a description of it? *A.*—We do not know that such boiler feeders are made at present. There have been various devices for this purpose, but we cannot recommend any of them. The late Henry R. Worthington used to relate his early experience with a device of this kind, and credit escaping with his life to good fortune. As generally contrived a float is connected with the throttle valve of a direct-acting steam pump, in such a way that when the water falls in the boiler it will open the throttle and start the pump, and when the water rises it will close the throttle. As Mr. Worthington used to put it, this may all go right ninety-nine times, until everything is thought to be safe, and then the one-hundredth time it may go wrong, with disastrous results. Our advice is, do not depend upon anything of the kind.

BUSINESS SPECIALS

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Mackenzie Cupolas and Blowers, 245 Broadway, N.Y.

Models & Mach'y—G. D. Lambert, New Haven, Ct.

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

Steel Name Stamps, &c J. B. Roney, Lynn, Mass.

Interchangeable work a specialty. Send stamp for new Lathe Catalogue. E. O. Chase, Newark, N. J.

For first-class machine patterns and estimates, address John Valentine, 15 Alling st., Newark, N. J.

INVENTIONS perfected, designed, or patented. E. P. Robbins, M. E., Cincinnati, O.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John street, N. Y.

Fine tools and special machinery. Horace Thurston, 84 Clifford street, Providence, R. I.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Wood Engraving done in best manner. Designs furnished. Edward Sears, 48 Beekman St. New York.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Patents.—Franck D. Johns, Att'y at Law & Solicitor of Patents, 617 Seventh St., Washington, D. C.

Pattern and Brand Letters. Vanderburgh, Wells & Co., corner Fulton and Dutch streets, New York.

Universal grinders for lathe-centers, chucks, angles, or cylinders. C. C. Hill, 84 Market st., Chicago, Ill

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 626 E st., Washington, D. C.

National and box chucks, foot and power lathes, and slide rests. Lodge, Barker & Co., Cincinnati, O.

For Sale—A valuable patent. A graduated gauge for measuring tapers. Address J. H. Fenety, 228 Shawmut avenue, Boston, Mass.

Split Pulleys at low prices, and of same strength and Appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Improved Tack Machinery, made by The Willets Man'f'g Co., can be seen in operation at their works, 57 Clifford St., Providence, R. I.

The "Wax Process" Engravings shown in the AMERICAN MACHINIST each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

Difficult machines invented and built; coarse screws cut. V rotary files for fine milling, by mail 50 cts. Tower Machine Works, E. Brookfield, Mass.

New Books, relating to steam, the steam engine, mechanics, machinery, and engineering. Send for catalogue. Fred. Keppy, publisher, Bridgeport, Conn.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large: prices low. Frasse & Co., 62 Chatham St., N. Y.

I have a well-equipped machine shop and foundry, and would be pleased to give estimates for building any kind of machinery. H. W. Bullard, Poughkeepsie, N. Y.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

"Catechism of the Locomotive."

The most complete and easily understood treatise on the locomotive; 625 pages, 250 illustrations $2.50. For sale by "The Railroad Gazette," 73 Broadway, New York.

EXTRACTS FROM CHORDAL'S LETTERS, 400 pages, 12mo., handsomely bound in cloth. New and enlarged edition, with over 50 illustrations. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

Useful Information for Steam Users—A 100-page pamphlet, compiled from the best authorities, on the care and management of the steam engine and boiler, with hints and rules for engineers and firemen. Engineers everywhere should have this work. Send 25 cents in P. O. stamps for a copy. The J. N. Mills Publishing Co., 145 Broadway, N.Y.

MANUFACTURES.

Fredericksburg, Va., and Chestertown, Md., will contract for city water works.

Repair shop and water works are to be built at Del Rio, Texas, by Major Converse.

W. J. Kincaid and others propose to erect a $50,000 bagging factory in Griffin, Ga.

Alexander Mason, of St. Louis, contemplates putting up a $30,000 flour mill in Dallas, Texas.

The New Britain (Conn.) Knitting Mills have ordered a new 80 horse power boiler, to add to their place.

G. D. Miller, New Haven, Conn., will erect a factory to cost $7,000, on Temple street, near George street.

Kearney & Foote, Paterson, N. J., are about to build a machine shop in connection with their file works.

The Vulcan Boiler Works (Schneider Brothers & Klein) is a new concern in Chicago. They have a shop 40x100 feet.

A new woolen mill is to be built at Pittsfield, Me. This will be the second woolen mill in operation at that place.

It is rumored that the Balcony Falls Manufacturing Company, of Balcony Falls, Va., will build an iron furnace.

H. B. Bigelow & Co., engine and boiler manufacturers, New Haven, Conn., will erect two new shops at a cost of $15,000.

Canning & Gill are building a wagon factory at Selma, Ala., and have already contracted for over 150,000 feet of timber.

Stock has been subscribed for a hat factory, paper mill, and cotton and woolen factory, all in one week, at Lampasas, Texas.

The Toledo (O.) Malleable Iron Company is erecting, as an addition to their factory, a brick building 45x75 feet, two stories high.

Twenty thousand dollars has been subscribed for a cotton-seed oil mill in Buena Vista, Ga. Fifteen thousand dollars more needed.

The cotton mills of Lowell, Mass., will shut down Saturdays, and those of Fall River run fewer hours per day, in order to decrease production.

It is reported that Landers, Frary & Clark are about to erect a factory on the corner of Elm and Commercial streets, at New Britain, Conn.

The coopers of Minneapolis, Minn., have formed another co-operative cooper shop. This makes six in successful operation at this time in that city.

D. W. C. Lomb, of the new cotton mills, Birmingham, Ala., reports that Northern capitalists have put $100,000 into the mill, which will be enlarged.

William Gleason, Rochester, N. Y., is employing sixty hands in the manufacture of machine tools. Shop is running full capacity, and outlook good.

The Westport Land and Building Company, of Westport, Conn., have just ordered two new boilers and an engine, from William Wright, of Newburgh.

Julius Lewis & Co., with others, have organized a cotton-seed oil company, with $40,000, in Raleigh, N. C. The company will also manufacture fertilizers.

William Baragwanath will erect at once, in Chicago, a shop 50x175 feet, for the manufacture of his feed-water heaters and purifiers. It will be running July 1.

The Sibley Manufacturing Company, of Augusta, Ga., have voted to expend $200,000 in putting 10,000 additional spindles and other machinery into their cotton mill.

The Birmingham Iron Foundry, of Birmingham, Conn., have just added a 50-horse power tubular boiler to their works, and business with them is said to be good.

The projected safe company has secured a site near the junction of the Cleveland and Pittsburgh and the New York, Pennsylvania, and Ohio roads, in the city of Cleveland, O.

Captain Norman Webb, of Selma, Ala., has paid $12,500 for a tract of land in Birmingham, Ala., on which he contemplates putting up a factory for manufacturing horse shoes.

William Frech, 70 Monroe street, Chicago has moved into his new machine shop, 35x100 feet, where he will manufacture monitor lathes, drill presses, and small machinery.

The Knoxville (Tenn.) Woolen Mills, recently incorporated with $180,000 capital, will proceed to build at once. C. J. McClurg is president, and R. P. Gettys secretary and treasurer.

Messrs. Drake, Warner & Seaton, the first being reported to be connected with the Peninsular Car Works, of Detroit, have secured land and will build car works in Birmingham, Ala.

Clark Brothers, Belmont, N. Y., are crowded with work, in their specialties of saw-mills and pumps. They are just putting in an additional 44" lathe, a large planer, and a drill press.

An Ohio firm has bought ground in McKinney, Texas, for a foundry and machine shop. J. P. Dowell, McKinney, can give their name and address. So says the *Baltimore Manufacturers' Record*.

Warden & Mitchell, builders of boilers, gas-holders, etc., have just completed an extensive building at Germantown Junction, Philadelphia, in which to carry on their business. They have a large amount of orders on hand.

The Extension Stove Pipe Company, Jamestown, N. Y., have lately commenced the manufacture of a patent extension stove pipe, which, by simply loosening a screw, can be extended or contracted to any desired length.

The Fort Worth Oil Mill and Manufacturing Company, of Fort Worth, Texas, capital $50,000, was incorporated May 1st. Incorporators: D. Boaz, S. W. Lomax, W. M. Lay, G. C. Battle, John Nicols, Martin Casey, and Thomas Roche.

A set of locomotive tires was recently turned up in the N. Y., W. S. and B. shops, at Syracuse, that had run 24,000 miles per 1-16 inch wear. They made an aggregate mileage of 98,000. The tires were made by the Chicago Tire and Spring Works.

H. K. Porter & Co., Pittsburgh, Pa., have just completed another locomotive for the railway on the Island of Yesso, Japan. The first two locomotives for this road were made by Messrs. Porter & Co., four years ago; two years later they made two more, and the present one makes the fifth.

Smith & Sayre Manufacturing Company, 245 Broadway, New York, inform us that they are running, full of work, on Mackenzie cupolas and blowers, also gas machinery; adding that business is improving lately among machine shops in Newark, N. J., where their own works are located.

The new Webber Wagon Company, who will erect works at Auburn, Ill., near Chicago, will put in $75,000 of machinery, both iron and wood-working. The buildings will cost $200,000, and the works will be ready to start near the close of this year. The present works are in Chicago. Henry Webber is president, W. H. Webber secretary and treasurer.

It is said that members of the Kelsey hat manufacturing concern in Newtown, Eng., are about putting up a large factory in Detroit, Mich., and will bring over five hundred of their workmen to start it. There is talk to the effect that they will ultimately employ five thousand hands, and seek to make pretty much all the felt and silk hats worn in the West.

The Medart Patent Pulley Company, St. Louis, Mo., are turning out 150 pulleys a day. They have just issued a new illustrated catalogue, containing views of the three floors of their extensive works, and a full price-list. The names of a large number of prominent concerns in the West who are using and recommending these pulleys are appended to the catalogue.

We have received a well-printed and bound catalogue, of over one hundred pages, from the Iron Bay Manufacturing Company, Marquette, Mich. It is copiously illustrated with cuts of the hoisting and pumping-machinery engines and boilers made by the company. The engravings are good, and the catalogue as a whole is far ahead of the average Eastern trade catalogue.

W. P. Davis, North Bloomfield, N. Y., writes us: The call for our new design 20" drill is good. We made four shipments of drills yesterday, going to the following points: Jackson & Tyler, Baltimore, Md.; Miller Company, Canton, O.; E. Harrington & Co., Manchester, N. Y.; Berry & Place Machine Company, San Francisco, Cal. We have sent the last-named firm five shipments of drills and key-seaters since December 23.

The S. H. & E. Y. Moore Manufacturing Company have purchased ground in close proximity to the depot at Deering, Ill., and will at once commence the erection of a factory 115x65 feet, for the manufacture of parlor and barn-door hangers, locks, and light hardware specialties. The machine shop, blacksmith shop, and foundry will be fully equipped with necessary tools and machinery. The works are expected to be in running order by June 1st.

C. C. Collins & Co. have erected and are about to equip a new machine shop, 60x40 feet, two stories high, at 88 to 94 Clay street, Newark, N. J. They will build steam engines, machinists' tools (such as shapers, lathes, and planers), also fit up shops with shafting, pulleys, and hangers. The members of the firm are C. C. Collins and Frank R. Smith. They will make a specialty of the erection and equipment of factories, giving personal attention to the same.

The Pratt & Whitney Company, of Hartford, Conn., have recently shipped a 48" pulley lathe, arranged to turn and bore at same time, to the Springfield Engine and Thresher Company, Springfield, O. Three 21"x12" engine lathes, with all attachments, to Calumet and Hecla Mine, Calumet, Mich.; one large-sized cold wire heading machine to a firm in Neuss, Germany, and to the Spenser Arms Company, Windsor, Conn. The last machines of the plant for the manufacture of the Spencer magazine rifle.

The *Roanoke* (Va.) *Leader* says: We learn that the machine works here have taken orders for ten passenger engines and nine moguls for the Norfolk and Western Railroad, besides several orders for the New River division. A force of eight skilled mechanics from Pittsburgh has recently been added to the works, and others from Renovo, Pa., are shortly expected. It is stated that the works have orders on hand to keep them fully running two years. The force is being largely augmented, and the utmost activity will henceforth prevail in every department.

The third annual meeting of the Nashua (N. H.) Co-operative Foundry Company occurred at Barker's Hall on Monday. The treasurer's report showed that the capital of the company is $16,000; assets, $31,000; surplus, included in assets, $6,000; liabilities, exclusive of current pay roll, $316. A dividend of 6 per cent. was declared. Officers were elected for the ensuing year, as follows: Directors, Timothy B. Crowley, Patrick Barry, John B. McKay, J. J. Sullivan, Jas. McWeeney, P. J. Flaherty, Patrick Connor, Morris Welch, and L. J. Ryan. Patrick Barry was chosen president, J. B. McKay clerk, and T. B. Crowley treasurer. Business is good with the company, and the outlook prosperous. As an experiment in co-operative production, this concern has thus far proved a very decided success.—*Boston Commercial Bulletin.*

The Osgood Dredge Company, of Albany, N. Y., write us: Two of our machines are working very successfully in digging phosphate rock in South Carolina. One of them is a dredge, with 12"x18" main engines and independent swinging engines, 7"x10"; this is working in Beaufort harbor. It is digging rock in twenty feet of water and beating all the dredges around there. I do not give you the number of yards excavated per day as that would be misleading. The dredge is idle part of the time, while the rock is being washed, the output being limited always by the capacity of crushed and washed. The other machine is a land excavator, and is working on the "Marsh," as it is called, owned by the Pacific company. Their property is near Beaufort. The rock lies about four feet under the surface of the ground. The superincumbent earth is removed and then the rock carefully gotten out. There is a good field down there for the use of power, where now much of the work is done by manual labor. We expect to send considerable machinery down there before long.

The Miller Company, Canton, O., will commence at once the erection of a new shop, to meet the wants of their increasing trade in steam pumps and mill machinery. They offer to sell the two buildings now occupied as foundry and machine shop, which will be vacated October 1st.

Machinists' Supplies and Iron.

NEW YORK, May 15, 1884.

There has been no notable change in the business connected with machinists' supplies during the week. There is a fair volume of business being done, but complaints are repeated that prices are unsatisfactory.

Steam goods are in fair demand, and the tone as to prices has improved since our last report was made.

Iron, pig, American—The market has ruled dull, with no material change in prices. The average of business is moderate, but for all standard brands prices have been maintained. No. 1 X Foundry, $20 to $20.50; No. 2 X Foundry $18.50 to $19; Grey Forge, $16.50 to $17.

Scotch—This market has ruled dull and barely steady, with sales mostly the result of concessions in price. We quote Shotts, $21.50 to $21.75 to arrive; Coltness, $21.50 to arrive; Glengarnock, $21 to arrive; Gartsherrie, $21.50 to $22; Eglinton, $19.50.

Copper—A firmer feeling has prevailed for ingot, with small sales of Lake at 14¼c. to 14¾c.

Lead—The market for common pig has ruled dull Prices range from 3.50c. to 3 60c.

Tin—There has been a firm but quiet market for pig. Banca, 20¼c.; Straits and Malacca, 19¾c.

✲WANTED✲

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Position as general foreman of railroad shop. Ten years foreman; five years foreman in last position. Address G. F., this office.

Situation wanted—By a first-class mechanical draughtsman and designer. Large and varied experience. Address N. D., Box 1492, Plainfield. N. J.

Wanted—A young, active pattern maker. Married man preferred. Steady employment for the right man. Must understand machinery and core work. The Miller Company, Canton, O.

An experienced, educated engineer desires employment, with chance to advance. Business combining commercial with professional work preferred. Address T. V., AM. MACHINIST.

A student, who has nearly completed the course required in the Hoboken Institute of Technology, in addition to a course in civil engineering, would like employment in either branch. Address C. H. Lindenberger, Defiance, O.

Situation wanted, as foreman of a boiler shop. Have had 20 years' experience as foreman, and am conversant with marine stationary and locomotive work. Address George Marshall, care AMERICAN MACHINIST.

Wanted—A very skillful machinist, for experimental work. One acquainted with gun work preferred. None but first-class need apply. Reference required. Apply to S. R. Krom, 93 Washington street, New York.

A thoroughly educated mechanical engineer and draughtsman, well posted in steam engineering, desires an engagement enabling him to prove his worth. Highest references from leading American and foreign shops. Has designed original machines for leading firms. Address "Box 7," AM. MACHINIST.

Situation wanted—By a foreman blacksmith, familiar with drawings and details, reverberatory furnace, steam hammer, marine and stationary and locomotive engine work, machine and job repair work—work up all scrap possible—good executive ability, reliable habits. First-class references given. Address A. B. C, care of AM. MACHINIST office.

FOR SALE—Harris-Corliss horizontal condensing double engine, cylinders 20x42 and 18x42. Wheel 16 feet diameter and 39 inch face. In good order; replaced by larger engine.

To be seen at Planet Mills, 372 President street, Brooklyn, N. Y.

MACHINE TOOLS FOR SALE

One Engine Lathe, 2nd hand, 7 ft. x 20 in.
" " " " " 8 ft. x 16 in.
" " " " " 9 ft. x 18 in.
" Upright Drill, - - 24 in. Swing.
" Iron Planer, - 5 ft. x 24 in. x 24 in.
" " " - - 9 ft. x 36 in. x 42 in.

ROLLSTONE MACHINE CO., FITCHBURG, MASS.

THE NEW PULSOMETER,

The cheapest, strongest, most simple, compact, durable, effective and economical Steam Pump in the market, for raising liquids under and up to 100 feet. No Machinery. No Oil. No Special Care. Can be worked suspended by a chain. Will pass grit, mud, sand, pulp, etc., without injury to its parts. Needs only a steam pipe from boiler to run it. Price, 600 gallons per hour, $50; 1,200 do. $75; 3,600 do. $100; 6,000 do. $150; 10,000 do. $175; 18,000 do. $225; 25,000 do. $275; 45,000 do. $400; 50,000 do. $500; 120,000 do. $1,000. Write for illustrated descriptive book with testimonials, etc. Mailed free. Pulsometer Steam Pump Co., 83 John St., New York.

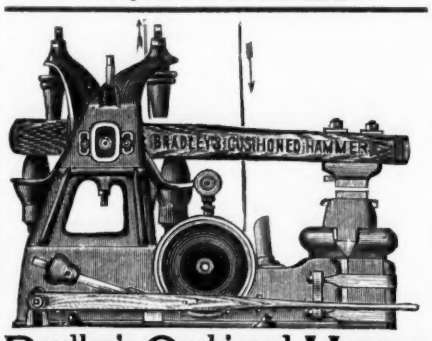
NOTES IN MECHANICAL ENGINEERING.

Compiled principally for Students, but also of great value to all Mechanical Engineers. By HENRY ADAMS. 93 pages, 12mo, $1. Descriptive Catalogue (100 pages) free

E. & F. N. SPON, 35 Murray St., N. Y.

HILL, CLARKE & CO.

36 OLIVER STREET, Boston, Mass.
BRANCH OFFICE, 800 N. 2nd STREET, St. Louis Mo.
Have just issued new
CATALOGUE
—OF—
LIGHT MACHINERY & SMALL TOOLS.
Sent free to Manufacturers and Dealers on receipt of their business card.



Bradley's Cushioned Hammer
Stands to-day WITHOUT AN EQUAL.
OVER 800 IN USE.
BRADLEY & CO., Syracuse, N. Y.
ESTABLISHED IN 1832.

All descriptions of Gear Wheels or Gear Cutting to order.
Large variety of Ready-made Gears in Stock.
Send for Gear Book, gratis.
GEO. B. GRANT, - 3 ALDEN STREET, BOSTON.

A BARGAIN.

Three locomotive-pattern **new** steel **BOILERS,** 60" diameter, containing 81 3½"x15'5" tubes, furnace about 8½' long x 5' wide x 6' high. Will carry 120 pounds steady working pressure.

One PLANER to plane 63" wide x 72" high x 23' long, in first rate order.

For full particulars address,

COOKE & CO.,
DEALERS IN
MACHINERY & SUPPLIES,
22 CORTLANDT ST., NEW YORK.

FOR SALE.

The following second-hand tools all in good order and for immediate delivery.

1—12½ in. Stroke Slotter.
1—10 in. " "
1—30 in. x 30 in. x 8 ft. Planer.
1—54 in. x 54 in x 16 ft. "
1—60 in. x 60 in. x 36 ft. " widens to
3—9 in. Stroke Shaper. 6 ft. 9 in.
1—17 in. Swing Lathe, 8 ft. bed.
1—20 in. " " 10 ft. "

HEWES & PHILLIPS IRON WORKS,
Cor. Orange and Ogden Streets,
NEWARK, N. J.

FOR SALE.

The property formerly occupied by THE WOODRUFF & BEACH IRON WORKS, now **HARTFORD ENGINEERING COMPANY.** Said property is unsurpassed as to shops and buildings, conveniently located for transportation by water and rail, with a FIRST-CLASS EQUIPMENT of MACHINE TOOLS, bought within two years, adapted to engine building and general machine work. FIRST-CLASS FOUNDRY; STEAM CRANE, CAPACITY 20 TONS. And the largest collection of PATTERNS of all descriptions in New England.

E. M. BUNCE, Receiver,
Hartford, Conn.

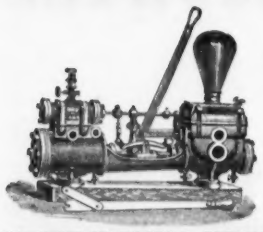
BORING MILL WANTED.

Good modern built Boring Mill, either new or second-hand, about eight feet swing. Address,

EDMUND M. IVENS & SON,
NEW ORLEANS, LA.

KNOWLES PATENT STEAM PUMPS.

THE STANDARD!



THE BEST MADE PUMP! THE BEST PUMP MADE!

Estimates furnished on application for Pumping Machinery of any capacity, and to work against any pressure.
Air Pumps and Condensers for steam Engines a specialty. Will save from 20 to 30 per cent. fuel.

SEND FOR ILLUSTRATED CATALOGUE.
—ADDRESS—

KNOWLES STEAM PUMP WORKS,
93 Liberty St., New York, and 44 Washington St., Boston, Mass.

The Deane Steam Pump Co.,

HOLYOKE, MASS.
92 & 94 Liberty St. NEW YORK. | 54 Oliver St. BOSTON | 49 N. 7th St. PHILA. | 226 & 228 Lake St. CHICAGO. | 620 & 622 N. Main St. ST. LOUIS.

MANUFACTURE
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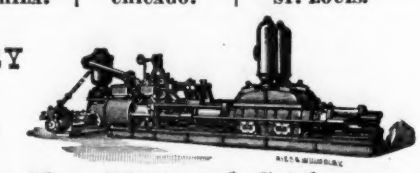

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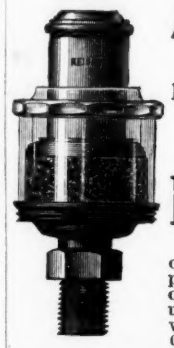

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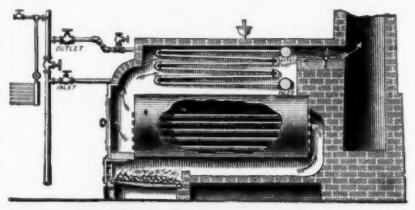

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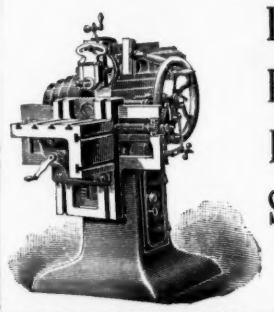

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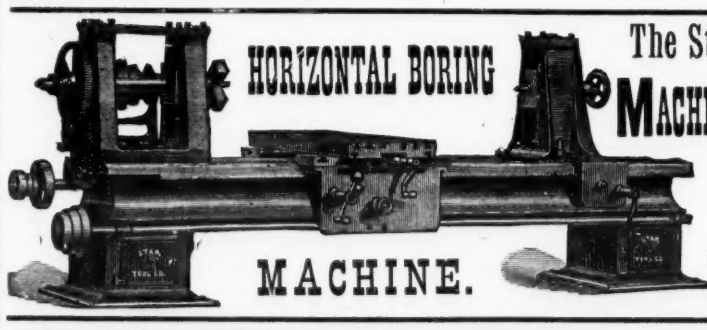

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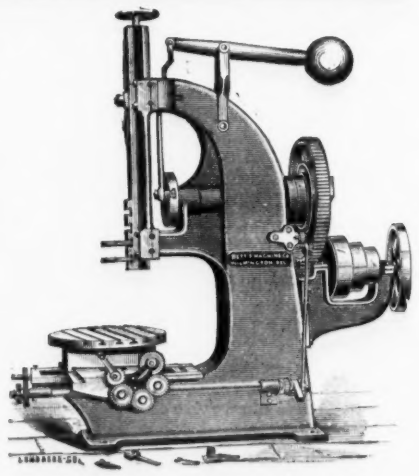

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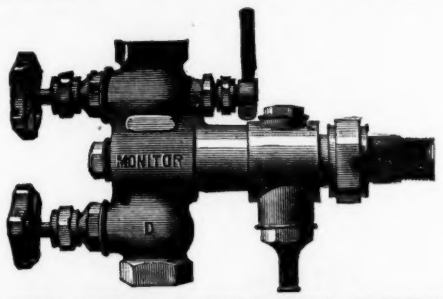

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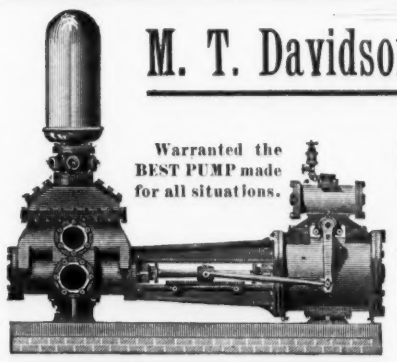

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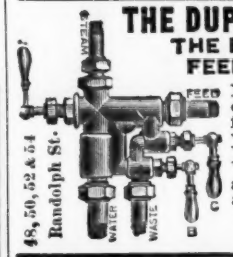

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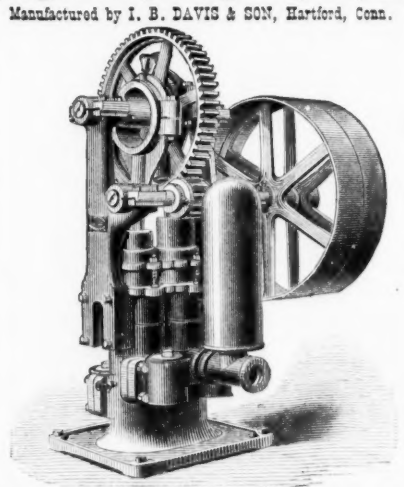

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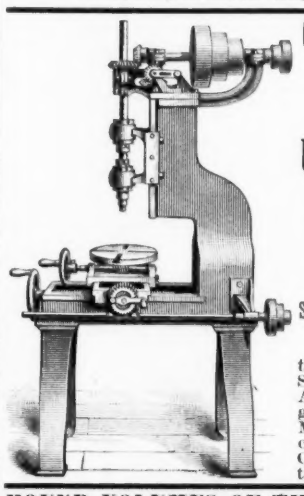

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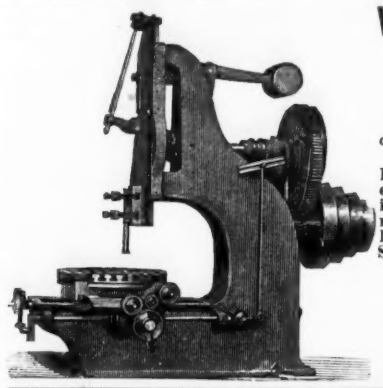

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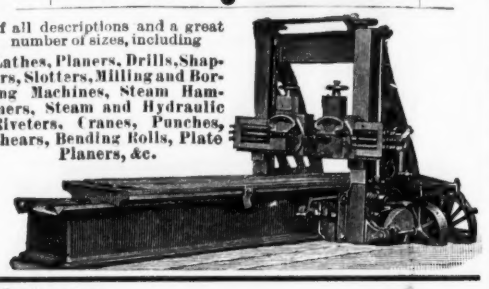

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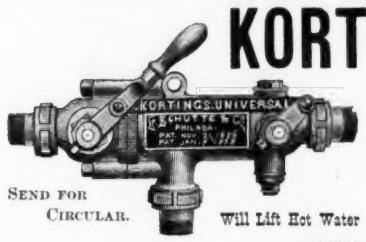

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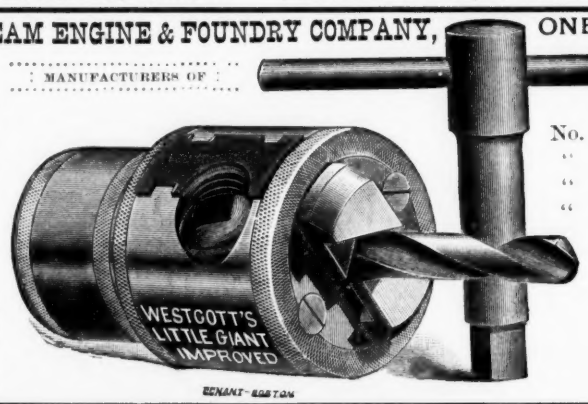

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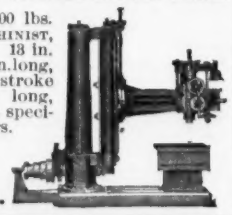

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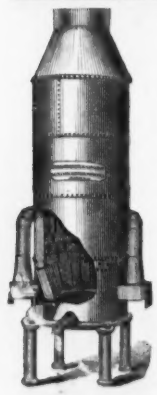

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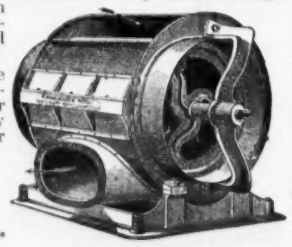

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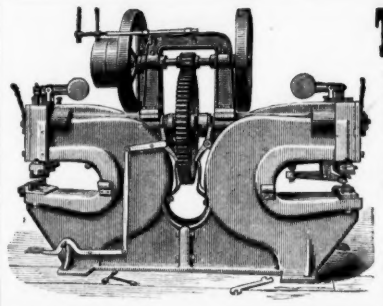

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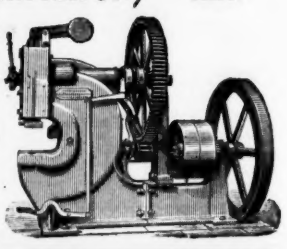

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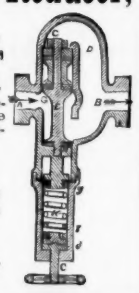

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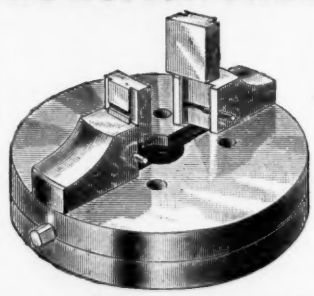

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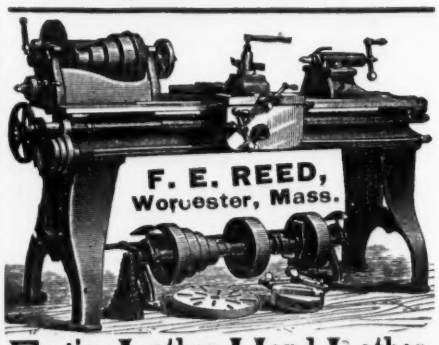

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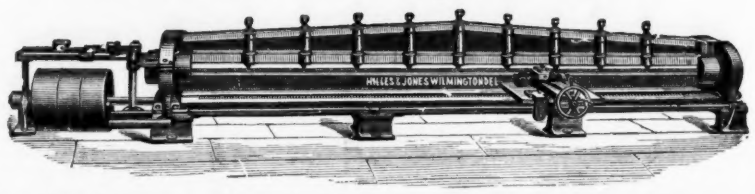

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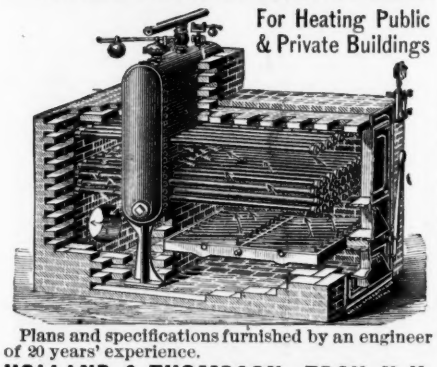

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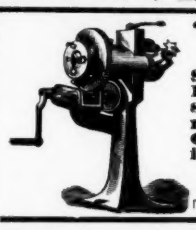

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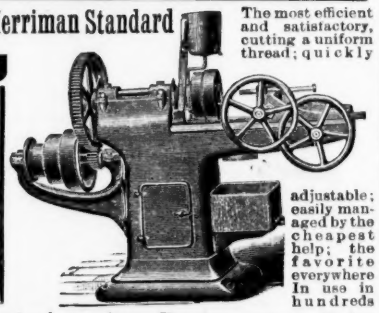

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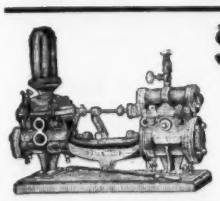

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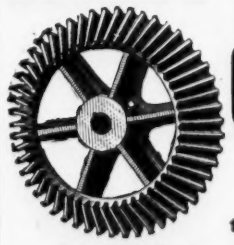

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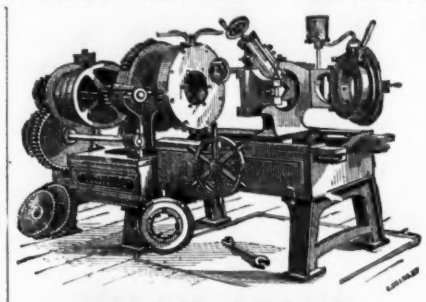

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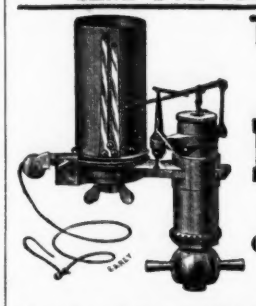

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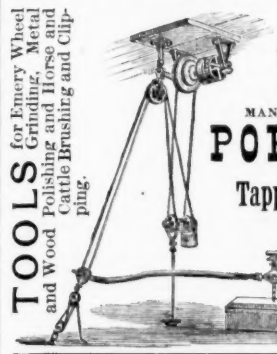

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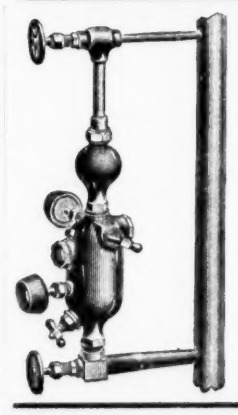

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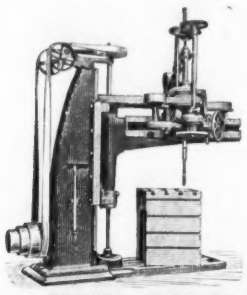

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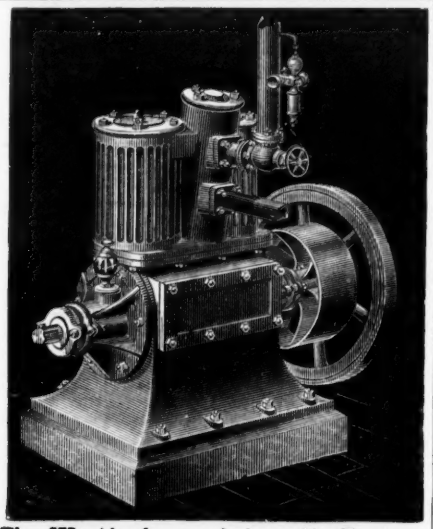

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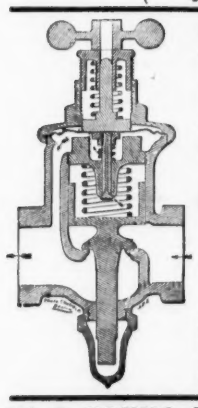

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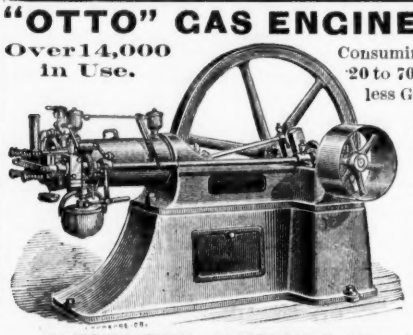

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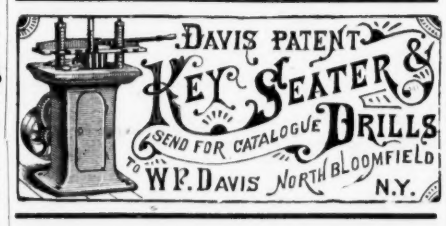

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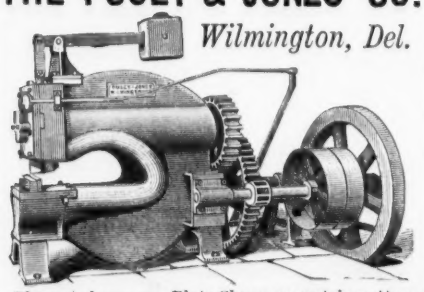

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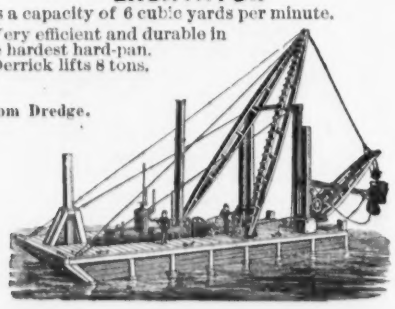

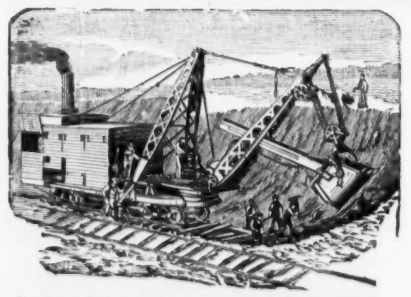

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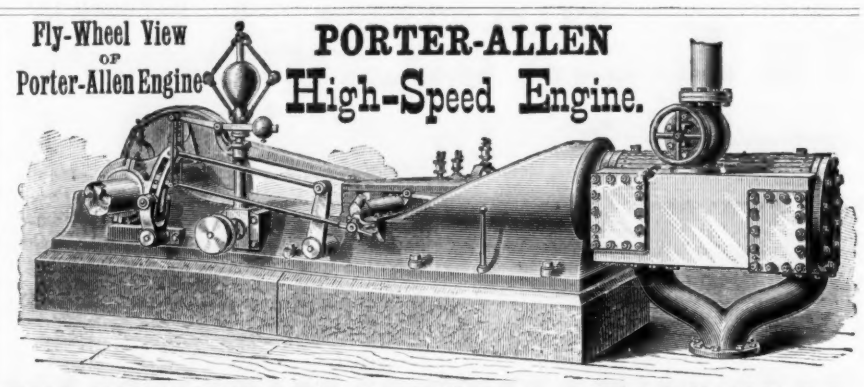

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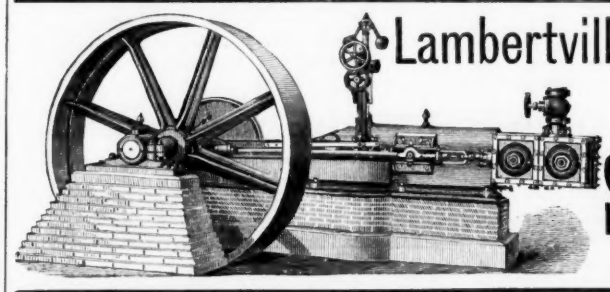

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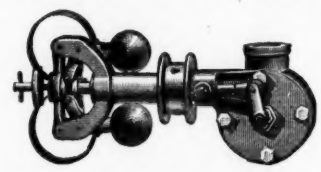

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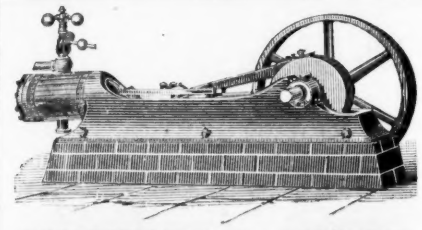

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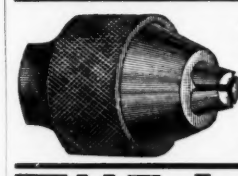

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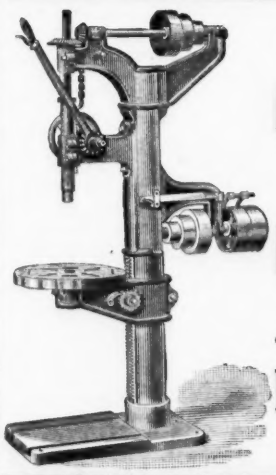

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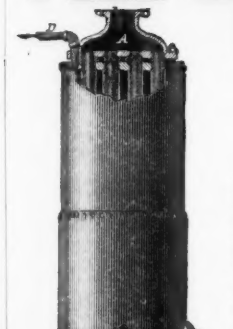

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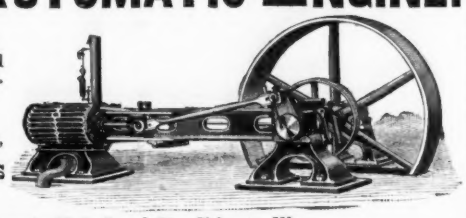

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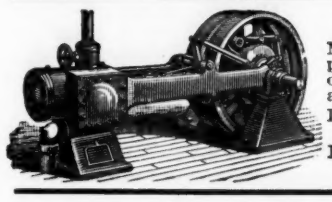

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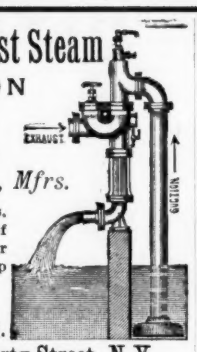

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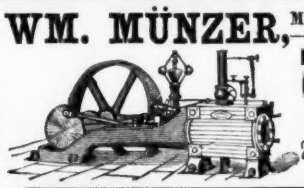

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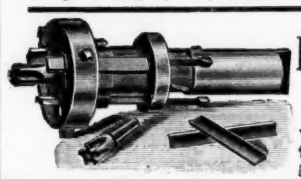

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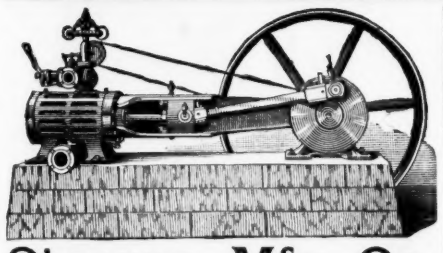

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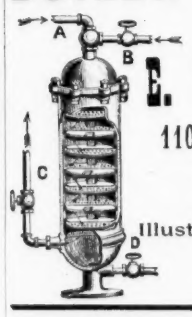

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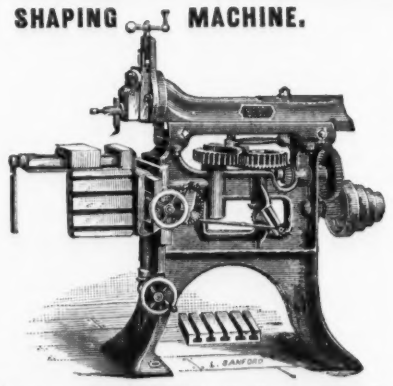

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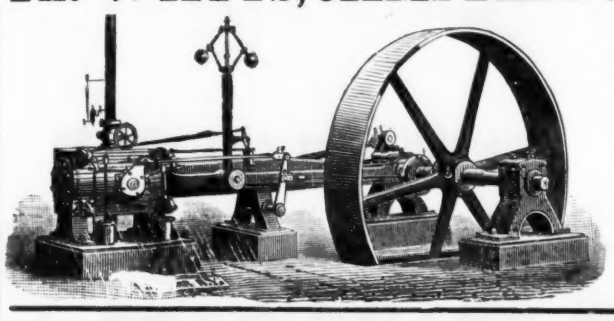

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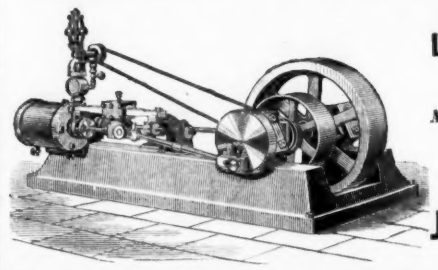

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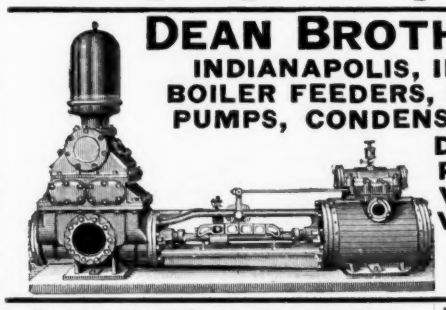

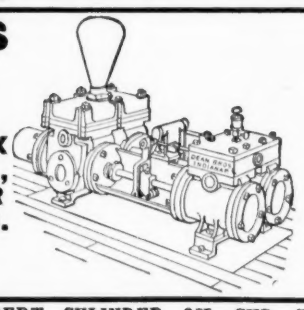

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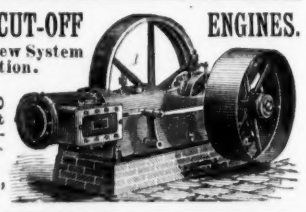

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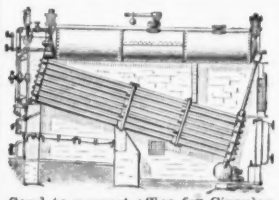

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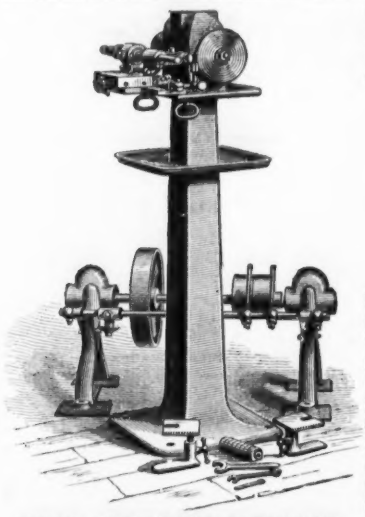

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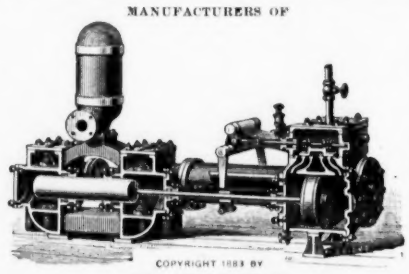

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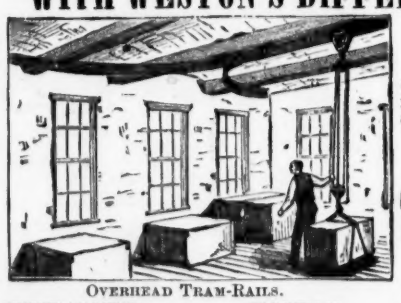

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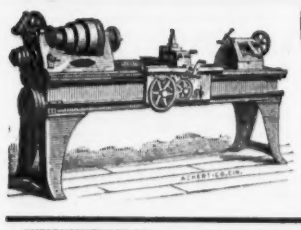

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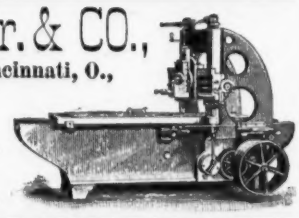

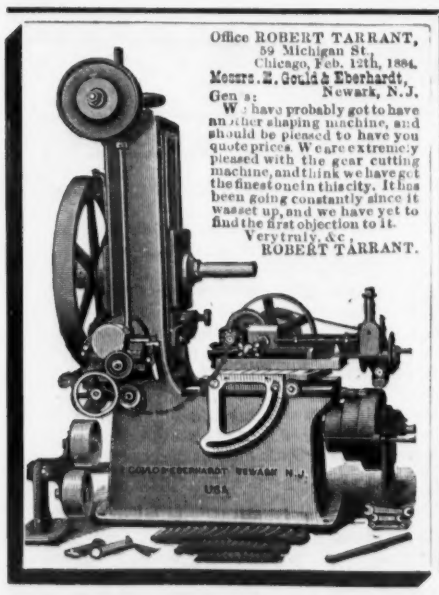

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Very truly, &c.,
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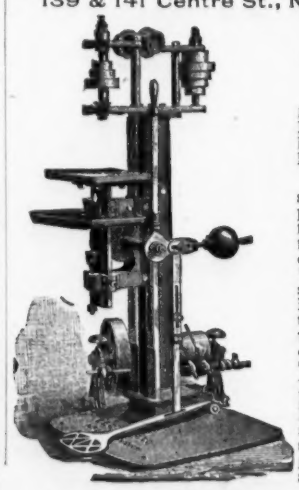

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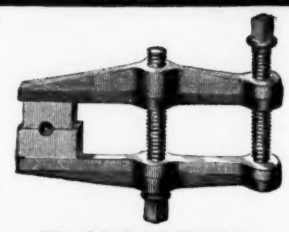

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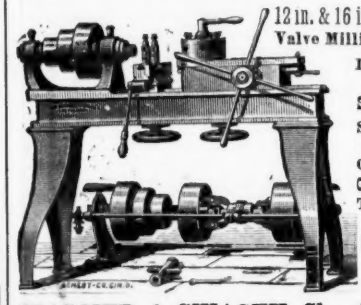

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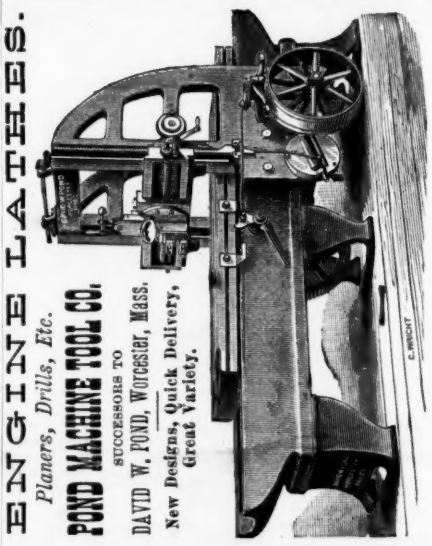

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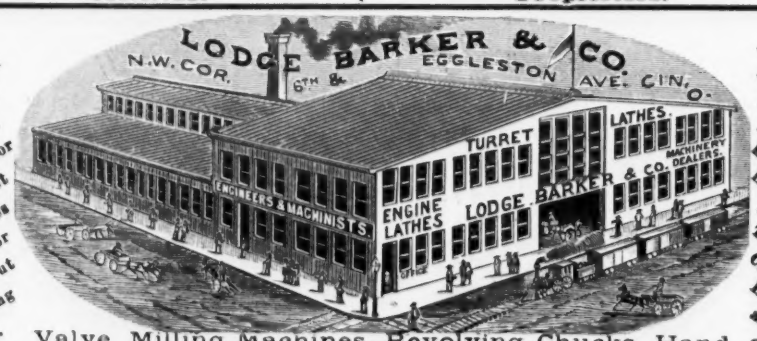

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